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Estudo dos fatores de risco cardiovascular numa população adulta da província do Bengo, Angola

Cardiovascular risk factors in an adult population of Bengo Province, Angola

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III. Pedro JM, Brito M, Barros H. Prevalence, awareness, treatment and control of hypertension, diabetes and hypercholesterolaemia among adults in Dande municipality, Angola. Cardiovasc J Afr. 2017; 28:1-10. doi: 10.5830/CVJA-2017-047

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VI. Pedro JM, Brito M, Barros H. Cardiovascular risk assessment in Angolan adults: a descriptive analysis from CardioBengo, a community-based survey. [Em revisão no International Journal of Hypertension]

Ao longo desta dissertação, colaborei ativamente na definição e operacionalização das hipóteses em todos os artigos, sendo responsável pela conceptualização e implementação da recolha dos dados, bem como pela análise estatística e interpretação dos dados que estes reportam. Fui responsável pela redação da versão inicial de todos os manuscritos e participei ativamente na preparação das suas versões finais.

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BMI - body mass index

CVD - cardiovascular diseases

CISA - Centro de Investigação em Saúde de Angola

DALYs - disability-adjusted life years

Dande-HDSS - Dande Health and Demographic Surveillance System

GDP - Gross Domestic Product

HDL - High density lipoprotein

ISH - International Society of Hypertension

LDL - low density lipoprotein

LMIC - low- and middle-income countries

MI - myocardial infarction

NCD - non-communicable diseases

PAR - population attributable risk

SSA – Sub-Saharan Africa

STEPS - STEPwise approach to Surveillance to chronic disease risk factor

WHO - World Health Organisation

Resumo

As doenças cardiovasculares (DCV) compreendem as principais doenças do coração e do sistema circulatório que fornecem o coração, o cérebro e os tecidos periféricos. As DCV são o principal grupo das doenças não transmissíveis (DNT), tendo causado 17,9 milhões de mortes em todo o mundo em 2015, número que aumentou globalmente em 12,5% desde 2005, com quase 80% dessas mortes ocorrendo em países de baixa e média renda. A sua ocorrência e mortalidade, perda de independência e produtividade, deterioração da qualidade de vida e custos sociais e económicos são razões imperiosas para preocupação.

Os fatores de risco para as DCV são partilhados com a maioria das DNT e são devidos à exposição a fatores de risco comportamentais: consumo de tabaco e álcool, dieta inadequada e inatividade física. Estes comportamentos influenciam o metabolismo e podem resultar em fatores de risco intermediários (metabólicos): obesidade, hipertensão arterial, diabetes e hipercolesterolemia. Há também fatores de risco de DCV que não podem ser controlados, como a idade, sexo, antecedentes familiares e etnia, e outros ligados a condições socioeconômicas ou o fenómeno da urbanização.

As DCV e os factores de risco associados têm sido negligenciadas na África Subsariana, mas têm aumentado com o envelhecimento e crescimento das populações. Tal como outros países da região, Angola não tem um sistema nacional de vigilância das DNT e apresenta um contexto social em rápida mutação. Com esta tese pretendemos contribuir para uma melhor compreensão da epidemiologia dos factores de risco das DCV em Angola, através do estudo de uma comunidade angolana adulta (15 a 64 anos) da zona de abrangência do Centro de Investigação em Saúde de Angola.

Para atingir esse objetivo, criamos e implementamos um protocolo de estudo e uma estratégia de acompanhamento para abordar a vigilância dos fatores de risco para as DCV (Artigo I) - o CardioBengo. A partir de uma investigação anterior, realizámos um estudo de acompanhamento da mesma população, para avaliar pela primeira vez a incidência de hipertensão arterial (Artigo II).

A partir dos dados extraídos do CardioBengo, foram realizados quatro análises (Artigos III a VI) referentes à caracterização da hipertensão arterial, diabetes, hipercolesterolemia, tabagismo e índice de massa corporal. Também analisou-se o conhecimento prévio, o tratamento e o controlo da hipertensão arterial, diabetes e hipercolesterolemia e avaliou-se o

agrupamento desses fatores de risco, comprovando dados adicionais para o planeamento de futuras intervenções.

Os próximos parágrafos descrevem o objetivo específico perseguido em cada análise, bem como a metodologia adotada e os principais resultados.

Estimar a incidência de hipertensão nos últimos dois anos e a associação com características sociodemográficas, antropométricas e comportamentais (Artigo II)

A partir de um estudo anterior realizado em 2011, 303 indivíduos em risco de hipertensão foram avaliados após 2 anos, seguindo a abordagem da Organização Mundial da Saúde *STEPwise*. A incidência cumulativa e o risco relativo foram calculados e o método de Cochran-Matel-Haenszel foi utilizado para calcular o risco relativo ajustado para a idade. A incidência cumulativa de 2 anos de hipertensão foi de 12,2%, semelhante em mulheres (12,2%) e homens (12,3%), significativamente maior nos indivíduos com mais de 40 anos (21,3% versus 8,1%) e de áreas rurais (25,0% versus 10,3% nas áreas urbanas). Consumidores regulares de álcool e indivíduos obesos ou com excesso de peso apresentaram risco significativamente maior de desenvolver hipertensão (2,5 e 2,3%, respetivamente). Entre os novos casos, existe uma baixa frequência de conhecimento prévio (37,8%) e tratamento (21,4%), sem qualquer caso controlado.

Quantificar a prevalência, o conhecimento prévio, o tratamento e o controlo da hipertensão, diabetes e hipercolesterolemia e a associação com características sociodemográficas, antropométricas e comportamentais (Artigo III)

Constituindo a linha de base do CardioBengo, 2.354 indivíduos com idades entre os 15 e os 64 anos foram avaliados quanto às características comportamentais, sociodemográficas e físicas. Foi aplicada um ajuste pós-estratificação para a obtenção das prevalências. Os *odds ratios* ajustados para cada variável relacionada às condições, foram calculados usando modelos de regressão logística. Em geral, a prevalência de hipertensão foi de 18,0%, da diabetes 9,2% e da hipercolesterolemia 4,0%. Entre os hipertensos, o nível de conhecimento prévio foi de 48,5%, 15,8% estavam em tratamento e 9,1% tinham a sua pressão arterial controlada. Apenas 10,8% estavam cientes de que tinham diabetes, 4,5% estavam em tratamento e 2,7% controlados. O nível de conhecimento prévio para a hipercolesterolemia foi de 4,2%, com 1,4% dos indivíduos em tratamento e 1,4% controlados. A prevalência de diabetes foi maior nos homens, e a hipertensão e a hipercolesterolemia em mulheres, com níveis de conhecimento prévio mais elevados entre indivíduos idosos e maiores níveis de educação. A obesidade e o tabagismo relacionaram-se com as três condições, sendo a prevalência de diabetes e hipercolesterolemia maior nas áreas urbanas.

Descrever o consumo de tabaco e a sua relação com as características sociodemográficas e determinar o nível de dependência de nicotina (Artigo IV)

A informação sobre a frequência e os determinantes do consumo de tabaco em Angola não está sistematizada. Analisando os resultados do CardioBengo, quanto ao tipo de consumo de tabaco e sua quantificação diária, estimamos a prevalência de tabagismo e valores médios de dependência de nicotina por gênero e variáveis sociodemográficas. Utilizámos a Abordagem *Stepwise* da Organização Mundial de Saúde e o Teste de Dependência de Nicotina de Fagerström para avaliar a dependência de nicotina. A prevalência de tabagismo diário foi de 6,1%, significativamente maior nos homens (10,0% versus 2,6%), e a de ex-fumadores foi de 7,5%, também maior nos homens. Apenas 0,2% relataram consumo de tabaco de mascar. Um terço dos fumadores relataram ter começado a fumar diariamente antes dos 18 anos. Os níveis de dependência de nicotina foram classificados como muito baixos ou baixos em 84% dos fumadores. A prevalência diária de tabagismo aumentou com a idade; foi também maior nas áreas rurais, nos indivíduos sem escolaridade, menores rendimentos e consumo de álcool.

Quantificar a prevalência de categorias de índice de massa corporal e avaliar a sua relação com características sociodemográficas (Artigo V)

Não existem dados nacionais de prevalência de obesidade para Angola, mas as tendências regionais apontam para um aumento. Dos 2.357 indivíduos com idade entre os 15 e os 64 anos do CardioBengo, foram recolhidas medidas antropométricas e dados sociodemográficos. As mulheres apresentaram uma prevalência significativamente maior de obesidade (10,5% versus 2,8%), mas a frequência da categoria abaixo do peso foi semelhante aos homens (10,2% versus 12,4%). O excesso de peso e a obesidade aumentaram com a idade, sendo o abaixo de peso a categoria mais prevalente na faixa etária dos 15 aos 24 anos, em ambos os sexos (18,5% nas mulheres e 18,4% nos homens). A obesidade foi mais prevalente entre os indivíduos que vivem com companheiro (em relação conjugal), diminuiu com a escolaridade (nas mulheres), mas foi maior nas áreas rurais e para aqueles com renda familiar mensal acima dos 150 dólares, em ambos os sexos.

Estimativa da distribuição da população por categorias de risco cardiovascular e elegibilidade para tratamento farmacológico (Artigo VI)

Nesta análise, estimamos o risco a 10 anos de um evento cardiovascular em 468 indivíduos com idades entre os 40 e os 64 anos que não estivessem a fazer terapia medicamentosa. Calculámos também a proporção de participantes elegíveis para tratamento farmacológico de acordo com valores clínicos isolados e o risco cardiovascular total. A maioria dos participantes foi classificada como tendo um risco cardiovascular baixo (<10%) a 10 anos

(87,6%), com apenas 4,5% apresentando um risco cardiovascular elevado (≥ 20%). Se considerarmos o critério único para a hipertensão arterial, 48,7% da população deve ser considerada para o tratamento com anti-hipertensivos, mas se aplicarmos a previsão de risco, esse número diminuirá para metade, para 22%, sem alterações no uso de hipoglicemiantes (19,0% em ambas as situações) e 3,8% para o uso de Estatinas.

Esta tese ajudou a criar uma linha de base estável para avaliar as DCV e os fatores de risco associados, que pode alimentar uma definição mais clara da política de saúde de Angola para as DCV e as DNT em geral. As principais conclusões são:

- O risco de hipertensão é alto nesta população, e mesmo com uma perda significativa de indivíduos no seguimento, este estudo gera a primeira evidência de que a hipertensão está a aumentar com o envelhecimento da população, estando associado à obesidade.
- A atual prevalência de hipertensão e diabetes também é maior, existindo também hipercolesterolemia. A prevalência da Diabetes e hipercolesterolemia foi maior entre os moradores urbanos, onde a prevalência da obesidade também foi maior. A urbanização está a marcar o aumento dos fatores de risco associados à dieta, especialmente entre as mulheres.
- Os baixos níveis observados de conhecimento prévio, tratamento e controlo de todas as condições indicam um alto fardo de condições não diagnosticadas e não controladas, colocando ênfase adicional na necessidade de intervenção nos cuidados de saúde primários.
- Esta população angolana apresenta uma baixa prevalência de tabagismo, com um baixo número de cigarros fumados diariamente e baixos níveis de dependência de nicotina, apesar dos baixos preços e fácil acesso aos cigarros fabricados. A implementação de intervenções restritivas mais fortes pode interromper e reverter a tendência observada na região africana do aumento do tabagismo.
- A prevalência de encontro de obesidade e baixo peso foi semelhante entre as mulheres, refletindo um estado de transição nutricional. Como em outras comunidades africanas, as mulheres apresentam uma maior prevalência de excesso de peso e obesidade, coexistindo valores semelhantes de baixo peso. Isto salienta a necessidade de programas de promoção e intervenções específicas para as mulheres, que lidem com a acumulação de fatores de risco.
- Existe uma necessidade urgente de tratamento farmacológico dos distúrbios cardiovasculares nesta população, integrada com medidas não farmacológicas. Isso pode ser feito usando a metodologia de previsão de risco, que melhora globalmente a eficácia das intervenções e reduz custos.

Abstract

Cardiovascular diseases (CVDs) comprise the major disorders of the heart and the arterial circulation supplying the heart, brain and peripheral tissues. In 2015, CVDs were the leading causes of non-communicable disease (NCD) deaths with 17.9 million deaths worldwide, a number that has increased globally by 12.5% since 2005. Almost 80% of these deaths occurred in low and middle-income countries. The common occurrence of CVDs and associated mortality, loss of independence and productivity, impaired quality of life and social and economic costs are compelling reasons for public health concern.

Risk factors for CVDs are shared with the majority of NCDs and are due to the exposure to behavioural risk factors: tobacco and alcohol consumption, unhealthy diet, and physical inactivity. These unhealthy behaviours influence metabolic pathways and ultimately result in intermediate (metabolic) risk factors: obesity, raised blood pressure (hypertension), sugar (diabetes) and lipids (dyslipidaemia). There are also some major CVD risk factors that cannot be controlled, like age, sex, genomics and ethnic differences, and others tied to socioeconomic conditions like education, urbanisation and economic power.

Cardiovascular diseases and associated risk factors in Sub-Saharan Africa have been negligible but are rising with the ageing and growing populations. Like other countries in the region, Angola has no national surveillance system for NCDs and presents a fast-changing social context. This thesis, aimed to contribute to a better understanding of the epidemiology of CVD risk factors in Angola, through the study of an adult Angolan community (15 to 64 years old) in the catchment area of the Centro de Investigação em Saúde de Angola.

To accomplish this purpose, we created and implemented a study protocol to create a baseline and an expected follow-up strategy to address the surveillance of risk factors (Paper I): the CardioBengo. From previous work, a follow-up survey was conducted to assess, for the first time, the incidence rate of hypertension in the same population (Paper II). From the data extracted from the CardioBengo baseline, four studies (Papers III to VI) were performed regarding the characterization of hypertension, diabetes, hypercholesterolemia, tobacco consumption and body mass index categories in this population. We also aimed to analyse the awareness, treatment and control of hypertension, diabetes and hypercholesterolemia and to assess the clustering of these risk factors, proving additional data for the planning of future interventions. The next paragraphs describe the specific objective pursued in each analysis, as well as the methodology adopted and the main results.

Estimate the incidence of hypertension in the last two years and the association with socio-demographic, anthropometric and behavioural characteristics (Paper II)

From a previous community-based study conducted in 2011, 303 individuals at risk for hypertension were evaluated after two years, following the World Health Organization (WHO) STEPwise approach to Surveillance procedures. Cumulative incidence and relative risk were calculated, and the Cochran-Matel-Haenszel method was used to compute sex-age-adjusted relative risk. The two-year cumulative incidence of hypertension was 12.2% and was similar in women (12.2%) and men (12.3%) but significantly higher in those over 40 years (21.3% versus 8.1%) and living in rural areas (25.0% versus 10.3% in urban areas). Regular alcohol drinkers and overweight or obese individuals presented a significantly higher risk of developing hypertension (2.5 and 2.3, respectively). Among incident cases, there was a low frequency of awareness (37.8%) and treatment (21.4%) without any controlled case.

Quantify the prevalence, awareness, treatment and control of hypertension, diabetes and hypercholesterolemia and the association with socio-demographic, anthropometric and behavioural characteristics (Paper III)

Constituting the baseline of the CardioBengo, 2,354 individuals between 15 and 64 years old were assessed for behavioural, socio-demographic and physical characteristics. Post-stratification survey weights were applied to obtain prevalence levels. Adjusted odds ratios for each variable related to conditions were calculated using logistic regression models. Overall, the prevalence of hypertension was 18.0%, of diabetes 9.2%, and of hypercholesterolaemia 4.0%. Among hypertensive individuals, the awareness level was 48.5%: 15.8% were on treatment, and 9.1% had their blood pressure controlled. Only 10.8% were aware they had diabetes: 4.5% were on treatment, and 2.7% were controlled. The awareness level for hypercholesterolaemia was 4.2%, with 1.4% of individuals on treatment and 1.4% controlled. The prevalence of diabetes was higher in men, and hypertension and hypercholesterolaemia higher in women, with awareness levels higher among older and educated individuals. Obesity and smoking were related to all three conditions, and the prevalence of diabetes and hypercholesterolaemia was higher in urban areas.

Describe the tobacco consumption and its relation to socio-demographic characteristics, and determine the nicotine level of dependence (Paper IV)

Information on the frequency and determinants of tobacco use in Angola are not systematised. By analysing the results from the CardioBengo baseline, regarding the type of tobacco consumption and its daily quantification, we estimated the prevalence of tobacco use and nicotine dependence mean values by gender and socio-demographic variables. We used the WHO STEPwise Approach to Chronic Disease Risk Factor Surveillance, and the

Fagerström Test for Nicotine Dependence to assess nicotine dependence. The prevalence of daily smoking was 6.1%, significantly higher in men than in women (10.0% versus 2.6%). Regarding ex-smokers, the prevalence was 7.5% (also greater in men). Only 0.2% reported smokeless (chewing) tobacco. One-third of every smoker reported having started smoking daily before the age of 18. The nicotine dependence levels were classified as 'very low' or 'low' in 84.0% of the smokers. Daily smoking prevalence increased with age and was higher in rural areas and in individuals with no formal education, lower incomes, and alcohol consumption.

Quantify the prevalence of body mass index categories and evaluate its relation to socio-demographic characteristics (Paper V)

No national prevalence data for obesity exists for Angola, but the regional trends point to a rise. Anthropometric measurements and socio-demographic data were collected from 2,357 participants, aged 15 to 64 years, of the CardioBengo baseline. Women presented a significantly higher prevalence of obesity than men (10.5% versus 2.8%), but women's the underweight frequency was similar to males (10.2% versus 12.4%). Overweight and obesity increased with age, with underweight being more prevalent in the 15-to-24-year age group in both sexes (18.5% in females and 18.4% in males). Obesity was more prevalent among individuals living with a companion (in a marital relationship), decreased with education (in females), but was higher in rural areas, and for those with a family monthly income above 150 US dollars in both sexes.

Estimate the distribution of the population by cardiovascular risk categories and its eligibility for pharmacological treatment (Paper VI)

In this analysis, we estimated the 10-year risk of a fatal or nonfatal major cardiovascular event (World Health Organization/International Society of Hypertension risk prediction charts) for 468 individuals aged 40 to 64 years not using drug therapy. We computed the proportion of untreated participants eligible for pharmacological treatment according to clinical values alone and total cardiovascular risk. Most of the participants were classified as having a low (< 10%) 10-year cardiovascular risk (87.6%), with only 4.5% having at least a high (≥ 20%) cardiovascular risk. If we consider the single criterion for hypertension, 48.7% of the population should be considered for treatment with antihypertensive drugs, but if we apply the risk prediction chart, this number reduces to 22.0%, without any changes for the use of hypoglycaemic drugs (19.0% in both situations) and 3.8% for the use of lipid-lowering drugs following the risk prediction chart.

This thesis helps to create a stable baseline to further evaluate CVDs and associated risk factors (socioeconomic, behavioural and metabolic) that can contribute to a clearer definition of Angola health policy for CVDs and NCDs in general. The major conclusions of this thesis are as follows:

- The hypertension risk is high in this population, and even with a significant loss of individuals in the follow-up, this study generates the first evidence that hypertension is rising with the ageing of the population and associated with obesity.
- The current prevalence of hypertension and diabetes is also higher, with hypercholesterolaemia also existing. Diabetes and hypercholesterolaemia were higher among urban dwellers, where obesity was also higher. Urbanisation marks the rise of diet-associated risk factors, especially among women.
- The observed low levels of awareness, treatment and control of all conditions indicate a high burden of undiagnosed and uncontrolled conditions, increasing the need for primary care intervention.
- This Angolan population presents a low smoking prevalence, with a low number of daily smoked cigarettes and low levels of nicotine dependency, despite the low prices and easy access to manufactured cigarettes. The implementation of stronger interventions at the beginning of the expected rise in smoking prevalence may halt and revert the tendency observed in the African region.
- The encountered prevalence of obesity and underweight was similar among women, reflecting a nutrition transition state. Like in other African communities, women present a higher prevalence of overweight and obesity, but the values of underweight were similar among sexes. This highlights the need for special health promotion and interventions designed to deal with the accumulation of risk factors for different disease groups in females.
- There is an urgent need for pharmacological treatment of cardiovascular disorders, integrated with non-pharmacological measures, in this population. This can be accomplished using risk prediction charts, which globally improve the efficacy of the interventions and reduce costs.

1. Introduction

Non-communicable diseases (NCDs), which include cardiovascular disease, cancer, diabetes, chronic respiratory disease and mental health conditions, are the leading cause of death worldwide. These diseases are responsible for almost 70% (38 million) of the world's deaths in 2012[1] and 39.8 million deaths in 2015.[2] This group of conditions, also known as chronic diseases, are non-transmissible between individuals, usually of long duration and slow progression, affect all ages and all regions, and often associated with older age groups and high-income countries.

Evidence shows that almost three-quarters of all NCD deaths occur in low- and middle-income countries (LMICs), and 16 million death attributed to NCDs occur before the age of 70, with 82% of these deaths occurring in LMICs,[1,3] making this disease group one of the major developing challenges in the near future as targeted by the World Health Organisation (WHO) "Global NCD Action Plan"[4] and included in the Sustainable Development Goals.[5]

Although globally life expectancy and age-standardised death rates are improving, mainly due to the reduction of deaths caused by infectious diseases, the burden created by CVDs, diabetes and cancer temper this trend, mainly among LMICs.[2] People in these countries are living well enough to develop these conditions but might not have access to the right treatment to avoid the rise of mortality due to NCDs.

Factors like the ageing of populations, rapid urbanisation and the globalisation of unhealthy lifestyles can drive the increase of NCDs in LMICs.[1,3] These processes are part of the theory of epidemiologic transition that links the change in patterns of health and disease with their demographic, economic and sociologic determinants and consequences.[6] In the transition across epidemiological stages, the leading causes of death and disability shift from nutritional deficiencies and infectious diseases in less developed countries to NCDs in more develop countries, putting some LMICs between transition periods, facing a double burden of diseases: communicable and non-communicable.

1.1. Cardiovascular diseases

Cardiovascular diseases comprise the major disorders of the heart and the arterial circulation supplying the heart, brain and peripheral tissues. Following the International Statistical Classification of Diseases and Related Health Problems (ICD 10), CVDs are mainly classified as Diseases of the Circulatory System (I00 to I99).[7] These ten conditions are

ischemic (or coronary) heart disease, cerebrovascular disease (e.g. stroke), hypertension and peripheral vascular disease (mainly due to atherosclerosis)[8,9], as well as rheumatic heart disease, cardiomyopathy, cardiac arrhythmia, congenital heart disease, deep vein thrombosis and pulmonary embolism.

1.1.1. Atherosclerosis and clinical presentation of cardiovascular diseases

Atherosclerosis is a complex pathological process, with the accumulation of fatty material and cholesterol inside the lumen of medium- and large-sized blood vessels. These deposits (plaques) cause the inner surface of the blood vessels to become irregular and the lumen to become narrow, making it harder for blood to flow through. The development of atherosclerotic plaque (atherogenesis) begins early in life and progresses over many years (usually decades) throughout the life span. The atherosclerotic plaque, whether fully matured or in intermediate stages of development, precipitate blood clot formation (thrombosis) with a sudden interruption of blood flow. A variety of outcomes may follow, depending on the location, severity and duration of the interruption.[8,9]

Ischemic (or coronary) heart disease is caused by the narrowing and obstruction of one or more blood vessels supplying the myocardium, and which may culminate in myocardial infarction (commonly known as heart attack). It is likely there is considerable variability in the process from patient to patient before a myocardial infarction (MI), but the common scenario involves rupture of an atherosclerotic plaque followed by platelet aggregation and possibly thrombotic occlusion in the right or left anterior descending or in the left circumflex artery. The result of such a process is significant necrosis of the myocardium, which can quickly progress to arrhythmia and sudden cardiac death.[9]

Cerebrovascular disease is caused by acute disruption of the blood supply to the brain due to either blockage (ischemic stroke) or rupture of a blood vessel (haemorrhagic stroke). As with ischemic heart disease, strokes are usually caused by atherosclerotic plaque either developing in place or dislodged from a larger (upstream) artery. Plaque rupture, platelet aggregation, and thrombotic occlusion may all be involved.[9]

Hypertensive heart disease occurs when the heart continually pumps against high resistance in the peripheral circulatory system. Resistance to blood flow in the peripheral arteriolar system increases with the constriction of blood vessels (vasoconstriction). As the peripheral resistance to blood flow increases, the heart (particularly the left ventricle) must work harder to maintain cardiac output. This sequence leads to left ventricle hypertrophy and dilatation

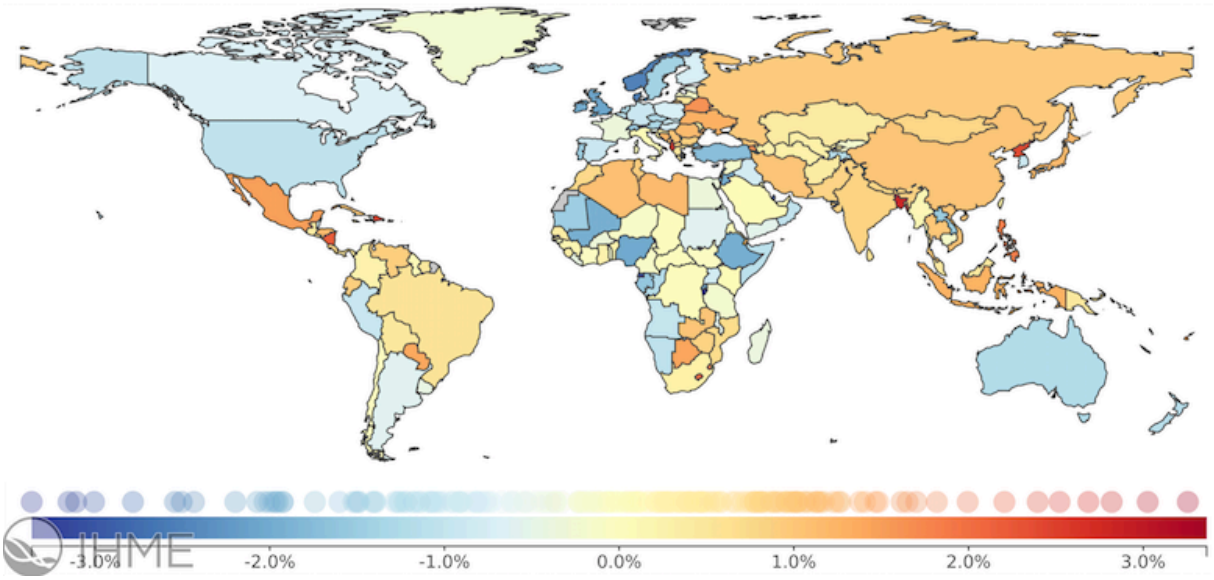
and may cause the pooling of blood in the left ventricular chamber (left-sided congestive heart failure). If there is long-standing high blood pressure in the lungs (pulmonary hypertension), the right ventricle may undergo hypertrophy leading to right-sided congestive heart failure (*cor pulmonale*).[9] Peripheral artery disease is caused by obstruction of the arteries (usually by atherosclerotic plaque) supplying the arms and legs. This condition is often a forerunner of ischemic heart disease due to atherosclerosis.[9]

1.1.2. Burden of cardiovascular diseases

Cardiovascular diseases were the leading causes of NCD deaths in 2015 with 17.9 million deaths worldwide, a number that has increased globally by 12.5% since 2005. Almost 80% of these deaths occurrs in LMICs.[2] Only two CVDs, MI and stroke, accounted for 85.1% of all deaths due to CVDs that year[2] and were the leading causes of disability-adjusted life years (DALYs) worldwide in 2015.[10] Their common occurrence and associated mortality, loss of independence and productivity, impaired quality of life and social and economic costs are compelling reasons for public health concern.[9]

Since 1990, there has been a global shift towards NCDs and CVDs as leading causes of death. CVD deaths are rising in LMICs (Africa, Asia and South America) and stagnating or even decreasing in high-income regions (North America, Europe and Oceania) (Figure 1) in different points of the epidemiologic transition.

Figure 1. Cardiovascular Diseases annual variation rate (%)
Both sexes, all ages, 1990 to 2015, deaths per 100,000



Source: Institute for Health Metrics and Evaluation, University of Washington, 2017.

The international patterns of CVDs can be divided into four distinct stages:[11,12]

i. Excess rheumatic heart disease and other inflammatory conditions in children and young adults (Sub-Saharan Africa, rural India and South America),
ii. Excess hypertensive heart disease in young and middle-aged adults (China and urban Asia),
iii. Rapidly increasing rate of MI and strokes, obesity and diabetes (urban India and Latin America),
iv. Decline of CVDs among adults (North America, Western Europe and Oceania).

A fifth stage was proposed for countries where social upheaval or war collapses the existing social and health structures of a region, leading to a resurgence of conditions seen in the first two stages, while third- and fourth-stage diseases persist (e.g., Russia).[11,12] This stratification was designed in 2001, and after 15 years, some regions have moved to the "upper" stages of the epidemiologic transition, with countries from Sub-Saharan Africa (SSA) distributed in phases 1 to 3.[11] A recent analysis that considers the ageing and growth of the population, puts central SSA in phase 2 (of 6) with increasing CVD deaths due mostly to population growth.[13]

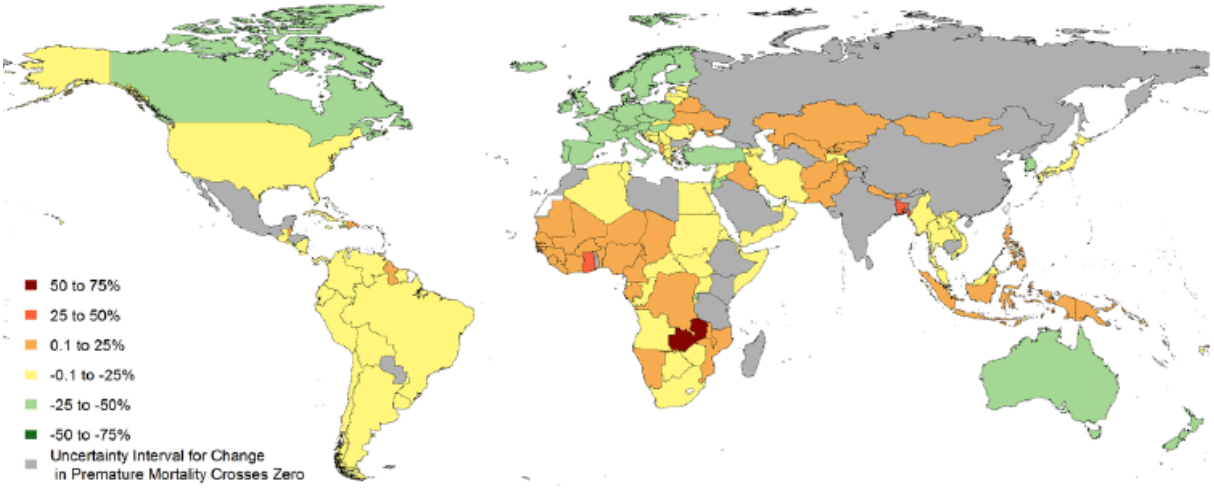
The prevalence configuration of the CVD is distinctly different in SSA than in the rest of the world, where an unprecedented decline in mortality and the corresponding increase in the expectation of life at birth are shifting the epidemiological landscape of the region. Large economic and social changes are occurring in many countries due to the postcolonial era, the end of civil wars and natural resource discovery. Some are beneficial to the population's health (economic growth and increasing access to health interventions), whereas others are associated with growing exposure to risk factors that lead to increased morbidity and mortality.[14]

Adult mortality as a public health issue in SSA remains neglected, with CVDs (and NCDs in general) coexisting with the conditions related to underdevelopment, such as malaria, malnutrition and tuberculosis. Infectious and inflammatory causes for CVDs are relatively more frequent, and atherosclerosis less, but this is not necessarily permanent when urbanisation and population ageing are ongoing.[15]

These countries face a double burden as they struggle to cope with NCDs and infectious diseases associated with a lack of socio-economic development.[14] This predicament is likely to worsen (Figure 2) because the majority of their populations are less than 35 years of age,

and the determinants and risk factors for CVDs are prevalent and increasing within this age group.[16]

Figure 2. Estimated percentage change in premature cardiovascular mortality, from 2013 to 2025, if risk factors continue their current trend



Source: Roth et al. Estimates of Global and Regional Premature Cardiovascular Mortality in 2025.[16]

The percentage of deaths by cardiovascular diseases for SSA, in 2015, was 11.2,[17] occupying the third place for mortality causes, whereas in 2010, this figure was 8.8%,[15] and in 1990, it was the fourth cause of death at 7.5%.[17] MI, together with strokes, were responsible for 10.8% of deaths among females and 8.6% in males in 2015 in the entire SSA region.[17] This represents an increase in mortality of 38.0% for strokes and 52.1% for MI in both sexes, since 1990,[17] revealing the rising trend of CVDs in SSA.

The estimates made for Angola follow the same pattern: strokes are responsible for 5.35% and MI for 4.65% of all deaths in 2015, making these the fourth and sixth causes of mortality in Angola, respectively.[17] For the age group above 50, strokes and MI are the first and second causes of death in Angola.[17]

In the area studied in this thesis, the Dande Health and Demographic Surveillance System (Dande-HDSS) Verbal Autopsy System reported that among the 407 reported deaths in individuals older than 15 years, from 2009 to 2012, 59 (14.5%) were due to circulatory system diseases, the leading cause of death attributable to a specific disease in this population for this period.[18]

1.2. Cardiovascular disease risk factors

Atherosclerosis is the underlying disease process in the blood vessels that causes the vast majority of CVDs. Factors that promote atherogenesis are known as risk factors, a term used for the first time in 1961, as a result of the Framingham Heart Study, a large longitudinal investigation that started in 1948 in Massachusetts, United States.[19] This ground-breaking epidemiological study of CVDs[18] was instrumental in the original identification of many factors associated with an increased risk of CVDs.[19,20]

Risk factors for CVDs (as a result of atherosclerosis) are shared with the majority of NCDs and are due to exposure to behavioural risk factors: tobacco and alcohol consumption, unhealthy diet and physical inactivity. These unhealthy behaviours influence metabolic pathways and ultimately result in intermediate (metabolic) risk factors: obesity, raised blood pressure (hypertension), sugar (diabetes) and lipids (dyslipidaemia).[1,8]

Common approaches that address behavioural and metabolic risk factors, which often coexist in the same person and act synergistically to increase the individual's total risk, are effective for prevention of CVDs and NCDs in general.[21] However, there are also some major CVD risk factors that cannot be controlled, like age, sex, genomics and ethnic differences, and others tied to socioeconomic conditions, like education, urbanisation and economic power.

1.2.1. Non-modifiable risk factors

The usual focus in cardiovascular epidemiology is the modifiable risk factors derived from unhealthy behaviours and the drivers of these behaviours, such as education level, urbanisation and economic status. However, the attributable burden of age, sex, genomics and ethnic differences must be taken into consideration to best understand patterns of modifiable risk factors, especially in populations where knowledge of this topic does not exist.

1.2.1.1. Age

The Framingham Study indicated an independent effect of age on CVD incidence, taking all the major risk factors into account.[19] The cardiovascular system is strongly affected by ageing, with clinical manifestations of atherosclerosis increasing with age.[22] Most of the health burden from risk factors for CVDs occurs at older adult ages,[23] with shifts in population age structures accounting for more than 23% of increased global mortality due to MI and strokes.[2]

There is a predominance of CVD deaths in older ages in developed countries, but for developing countries, CVD deaths are more prominent among younger individuals.[23,24] The onset of CVDs in these countries is 10 to 15 years earlier than that of developed countries,[25] and DALYs account for this difference by giving a higher weight to deaths at younger ages.[23] In SSA, adults are more likely to die from a non-CVD cause compared with the rest of the world, and the region has the lowest years of life lost due to CVDs: the mean age of death by CVD in SSA is 65 years old, the lowest in the world.[15]

In addition to the intrinsic outcome in the structural and functional changes in the heart and vessels, it may be that ageing is also a reflection of the length of exposure to the burden of modifiable risk factors.[22] In cardiovascular epidemiology, the effect of age is often removed to isolate these factors. However, health-system planning also requires an understanding of the full burden of disease and the effect of ageing. The use of age-specific prevalence can assist in this analysis.[13]

1.2.1.2. Sex

The most common cause of death in women, as in men, is CVDs, but the percentage of global deaths is higher: 34.1% for women and 30.5% in men in 2015.[17] Men are generally at greater risk for CVDs than premenopausal women at similar ages. After menopause, however, blood pressure increases in women to levels even higher than in men.[26]

The female life expectancy is greater than the male, and women who develop CVDs tend to be elderly, which creates specific management issues because older women are likely to suffer from comorbidities, such as diabetes and hypertension, important risk factors.[27] This conjunction of factors can explain the worse outcomes for CVDs in women.

Rarely CVD is presented as a women's health problem, namely in developing countries, where health interventions are frequently concentrated on maternal and reproductive health. The impact of a CVD in females is direct when they experience the illness themselves (with higher levels of morbidity and mortality), but also indirect when their socio-economic circumstances are affected by death or disability among family members.[24]

1.2.1.3. Family history

The majority of early cardiovascular events in a population occur in families with a positive family history of CVD and can sometimes be the crucial and single most important risk factor in predisposing an individual to early disease.[28] A large proportion of MI or strokes occurring at a young age could be attributable to inherited or familial predisposition.[29] Sudden cardiac death in youth is defined as death prior to 40 years old from an identified or suspected cardiac cause, usually heritable cardiomyopathies, primary electrophysiologic disorders, congenital heart disease or early coronary artery disease.[30]

A family history paired with an examination of relatives may lead to a more precise diagnosis and the identification of multiple individuals at risk, helping to guide preventive efforts. A family history of CVD is defined as having a male first-degree relative experiencing the first manifestation of CVD under the age of 45 or a female first-degree relative under the age of 55.[28,29]

Also, part of the genetic heritage is familial hypercholesterolemia, an autosomal dominant condition associated with high levels of total and low-density lipoprotein (LDL) cholesterol. The individual inherits a defective LDL cholesterol receptor gene from one or both parents. At least 50% of males and 30% of females with familial hypercholesterolemia who do not receive effective treatment will experience a coronary event before the age of 50.[31]

1.2.1.4. Ethnicity

Ethnicity is a categorisation of individuals who share similarities, such as common ancestral, language, social, cultural or national experiences. The use in public health of this categorisation occurs because people identified as members of particular ethnic groups often differ in disease rates or risk factor distributions from other groups. Group membership defined by ethnicity may indicate genetic, cultural, socioeconomic or other differences, and interpretation of related differences in health and disease may require deep investigation.[9]

The ethnic composition of populations is also implied in differences in the CVD burden and outcomes, attributable to biological, cultural, healthcare and social issues. The understanding of ethnic differences in health is beneficial to minorities, and it contributes to decreasing health inequalities in a broad sense.[32] An increased stroke rate is noted for Blacks, some Hispanic Americans, Chinese and Japanese populations, and increased CVD deaths are noted for South Asians and American Blacks in comparison with Whites.[33]

Cardiovascular disease rates among Blacks in Africa are relatively low when compared with the rates in most western countries, like the prevalence of most conventional risk factors. Exception are made for hypertension, which is higher among Blacks than other groups within Africa and the world.[33] Hypertension among Blacks occurs at a younger age and often involves more severe blood pressure levels than among Whites. This is due to a complex interaction between environmental responses to diet and stress and a potential genetic/physiological difference in sodium/potassium excretion, which together with obesity (especially among women) may be part of the explanation. Black patients with hypertension are particularly vulnerable to strokes and hypertensive kidney disease. They are three to five times as likely as Whites to have renal complications and end-stage kidney disease.[34]

1.2.2. Modifiable risk factors

More recent and larger population studies of cardiovascular risk factors, like the MONICA project and the INTERHEART study,[25,35] focused on modifiable risk factors. In this section, we will focus on hypertension, diabetes, hypercholesterolemia, tobacco use and overweight and obesity. Raised blood pressure, glucose and cholesterol, and overweight and obesity are directly linked to unhealthy diets as further discussed.

Regarding attributable deaths worldwide, the leading CVD risk factor in 2004 was raised blood pressure, followed by tobacco use, raised blood glucose, overweight and obesity, and high blood cholesterol.[23] In Table 1, different attributable results to each modifiable risk factor are listed from the world and African population of the INTERHEART study.[25,36]

Table 1. Compared attributable results for each risk factor, globally and in Africa, in both sexes

	Attributable deaths World, 2004[23]	**PAR* World, 1999-2003[25]**	**PAR* Africa, 1999-2003[36]**
Raised blood pressure	12.8%	23.4	29.6
Raised blood glucose	5.8%	12.3	16.7
Raised blood cholesterol	4.5%	-	-
Tobacco smoking	8.7%	36.4	38.9
Overweight and obesity	4.8%	-	-

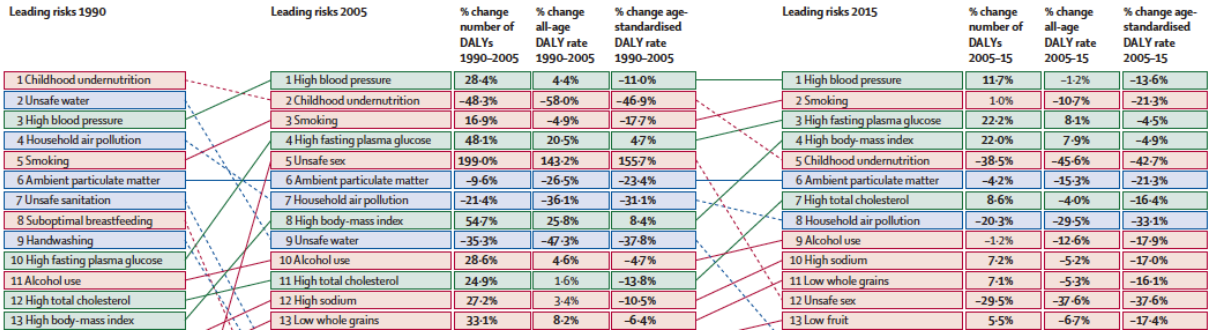
* PAR - population attributable risk

Updating these values to 2015, raised blood pressure is also one of the principal risks for both sexes, contributing to 9.2% of DALYs for men and 7.8% for women. Smoking was the second-leading risk factor for men in 2015, contributing to 9.6% of DALYs and a large proportion of male disease burden from CVDs. In 2015, raised blood glucose was associated

with 6.0% of DALYs for men and 5.6% for women. Both raised blood glucose and overweight and obesity have increased by more than 20% since 1990.[37]

The evolution of the five risk factors, the object of this thesis, can be observed in Figure 3. All five have been rising since 1990 and, in 2015, were among the seven leading risk factors for DALYs, globally, in both sexes.[37]

Figure 3. Leading global risk factors for DALYs for both sexes combined, 1990, 2005 and 2015, with percentage change in number of DALYs, and all-age and age-standardised rates



Source: GBD 2015 Risk Factors Collaborators. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015.[37]

Specifically, among the African population participating in the INTERHEART study, five risk factors (smoking, diabetes, hypertension, abdominal obesity and an elevated apolipoprotein B to apolipoprotein A-1 ratio) accounted for 89.2% of the population attributable risk for the first myocardial infarction.[36] The same study suggested that uncontrolled major risk factors have a larger impact on the burden of CVDs in Africa than elsewhere in the world.

If the current trends persist, the risk of dying from NCDs will increase in the African region. However, this rising risk could be reversed by reaching the proposed targets for six risk factors (tobacco use, alcohol use, salt intake, obesity, increased blood pressure and glucose levels) out of the nine global targets proposed by the WHO Global NCD Action Plan.[4,38]

1.2.2.1. Hypertension

Blood pressure is created by the force of blood pushing against the inner walls of blood vessels. Measured in millimetres of mercury (mmHg), this force is recorded as systolic blood pressure and diastolic blood pressure. Systolic blood pressure is the highest pressure in blood vessels and happens when the heart contracts; diastolic blood pressure is the lowest pressure in blood vessels and occurs in between heartbeats when the heart muscle relaxes. The higher the pressure in blood vessels, the harder the heart has to work.[39] Most hypertensive individuals do not present any symptoms but sometimes have headaches, shortness of breath, dizziness, chest pain, heart palpitations and nose bleeds.[39]

Raised blood pressure (hypertension) is defined as a systolic blood pressure of 140 mmHg or higher, a diastolic blood pressure of 90 mmHg or higher, or both. The systolic blood pressure is the basis for diagnosis in most patients.[34,39] About 95% of adults with raised blood pressure have primary hypertension, with the remain 5% classified as secondary hypertension, mainly driven by chronic kidney disease.

The causes of primary hypertension are not known, although its connection with ageing, genetics and unhealthy lifestyles (sedentary life, tobacco and alcohol consumption) and diet (obesity, salt intake and cholesterol) is well known.[34,39] Multiple clinical trials provide evidence that lowering blood pressure decreases the risk of future cardiovascular events, stroke and end-stage renal disease.[40]

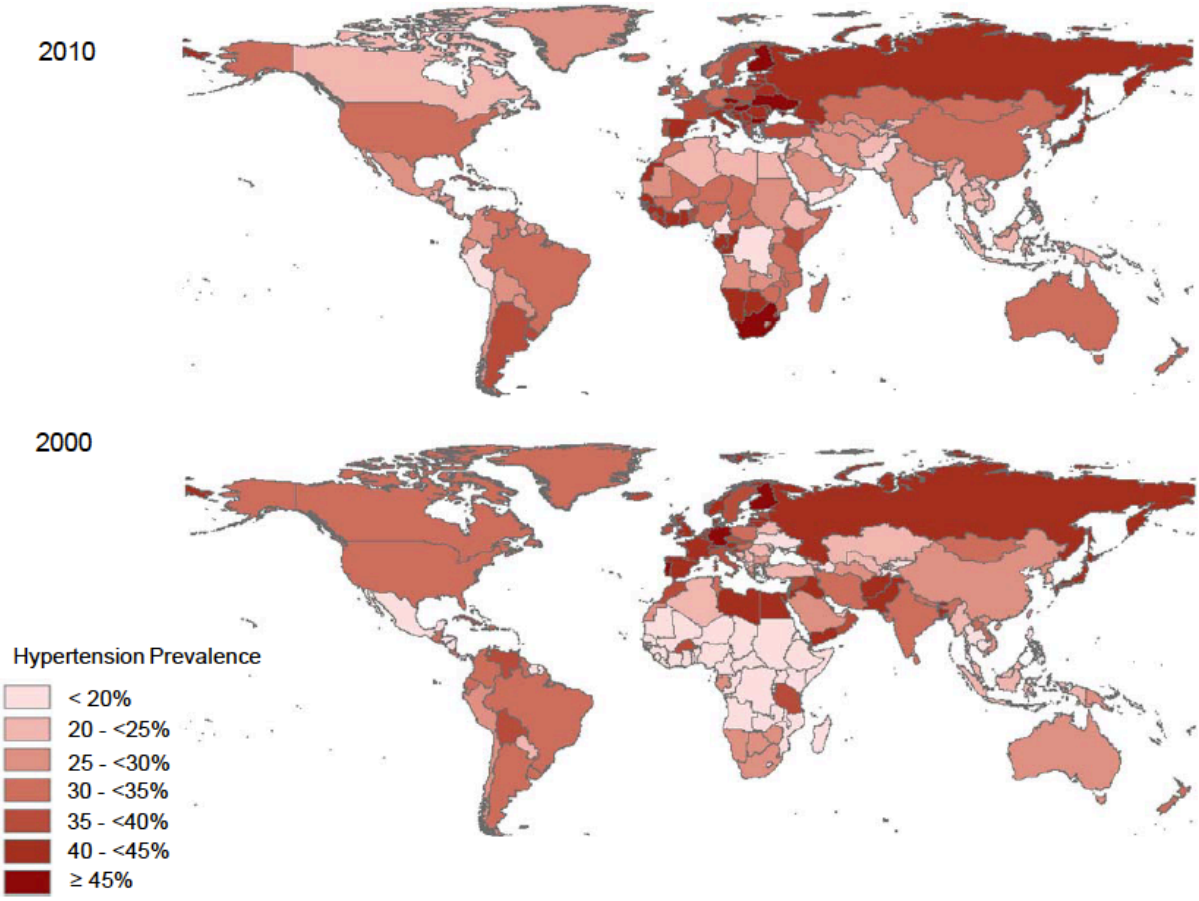
The goal of treating hypertension is to reduce blood pressure to levels below the numbers used for making the diagnosis and deal with all other identified risk factors for CVDs: lipid disorders, diabetes, obesity and smoking. Furthermore, hypertension management implies significant lifestyle changes.[1,4,21,34,39]

Hypertension was the most important risk factor globally in 2015 (Figure 3), with 211.8 million DALYs[37] as the most important cause of CVDs.[1,4,37,39] Since 1975, mean blood pressure has decreased in high-income countries and increased in low-income countries in South Asia and SSA.[41] The number of adults with hypertension increased from 594 million in 1975 to 1.13 billion in 2015, largely in LMICs.[41]

In 2010, approximately 75% of people with hypertension were living in LMICs where hypertension prevalence was higher (31.5%) than in high-income countries (28.5%).[42] The African Region presented the highest estimated prevalence of hypertension (30%) in all

adults across WHO regions in 2014[1] and, in 2010, the highest prevalence in women (36.3%).[42] The global age-standardized prevalence of hypertension was 25.9% in adults 20 years or older in 2000, with an increase of 5.2% over ten years. Although this prevalence decreased by 2.6% in high-income countries, in LMICs it increased 7.7% (Figure 4).[42]

Figure 4. Worldwide age- and sex-standardized prevalence of country-specific hypertension in 2000 and 2010 in individuals ≥20 years



Source: Adapted from Mills et al. Circulation, 2016.[42]

Also at the level of hypertension awareness, treatment and control disparities occur between high-income countries and LMICs. High-income countries had almost double the proportions of awareness (67.0% versus 37.9%) and treatment (55.6% versus 29.0%) and four times the proportion of control among patients with hypertension (28.4% versus 7.7%) in comparison with LMICs in 2010.[42]

1.2.2.2. Diabetes

Diabetes mellitus is a chronic disease that arises when the pancreas fails to produce enough insulin (type 1 diabetes) or when the body cannot effectively make use of the insulin produced (type 2 diabetes). Failure of insulin secretion, action or both leads to raised blood glucose and other metabolic changes, which if uncontrolled, can cause retinopathy, nephropathy, neuropathy and CVDs.[43-45]

Other types of diabetes (*e.g.,*. gestational diabetes) and lesser degrees of abnormal glucose levels (impaired glucose tolerance and impaired fasting glycaemia) are not described in this thesis. When the clustering of type 2 diabetes with several other CVD risk factors, such as obesity, dyslipidaemia, hypertension, insulin resistance and microalbuminuria occurs, a condition named metabolic syndrome is developed.[44,45]

Diabetes is typically diagnosed by a glycated haemoglobin (HbA1c) level of 6.5% or greater, fasting glucose of 126 mg/dL (7 mmol/L) or above, or a glucose level of at least 200 mg/dL (11.1 mmol/L) from the non-fasting state or after a two-hour post-load glucose challenge test.[46] The pharmacological treatment of such condition requires insulin for type 1 and oral hypoglycaemic agents for type 2.

Although for type 1 diabetes there are no prevention measurements, with the majority of the cases occurring in children and adolescents, modifiable factors exist to prevent type 2 diabetes: weight management, healthy diet, physical activity and smoking cessation.[43] Also ethnicity, family history of diabetes and previous gestational diabetes combined with older age are risk factors for type 2 diabetes.[43-45]

In 2015, there were 1.5 million deaths worldwide directly caused by diabetes, which was the seventh cause of death among both sexes,[17] with the total deaths from high blood glucose rising to 5.2 million in the same year.[17] Diabetes is an important risk factor for CVDs and other diseases; adults with diabetes have a two or three times higher rate of CVDs than adults without diabetes.[21,43-45,47-48]

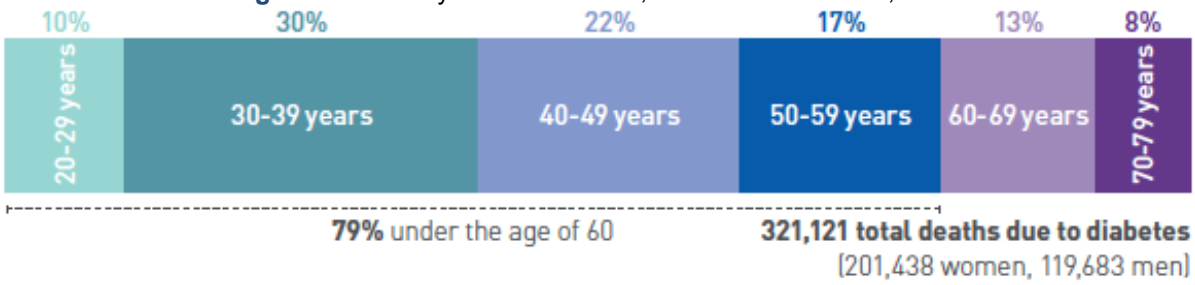
Since 1980, the number of people with diabetes has steadily risen. Worldwide, the number of individuals rose from 108 to 422 million (four times higher). Forty percent of this increase is estimated to result from population growth and ageing, 28% from a rise in age-specific prevalence, and 32% from the interaction of these factors.[49] Thus, the global prevalence of diabetes has grown from 4.7% in 1980 to 8.5% in 2014, during which time prevalence has

increased, or at best remained unchanged, in every country. Over the past decade, diabetes prevalence has risen faster in LMICs than in high-income countries.[49]

In 2015, 8.8% of adults (20 to 79 years old) were estimated to have diabetes, and 75% of these adults lived in LMICs.[47] If the current trend persists, by 2040, this number will increase to 642 million people, a prevalence of 10.4%.[47] The SSA region will rise from the present prevalence of 3.2% to 3.7% in 2040, doubling the number of people with diabetes (from 14.2 to 34.2 million). SSA also has the highest proportion of undiagnosed diabetes (66.7%).[47]

As urbanisation increases and populations age, type 2 diabetes will pose an ever-growing threat, as current trends in the last decades prove.[50-53] In 2015, around 320 thousand deaths in SSA could be attributed to diabetes, with 79.0% of those deaths occurring in people under the age of 60, the highest proportion of any region. Diabetes-attributable mortality was 1.7 times greater in women than in men (Figure 5).[47]

Figure 5. Mortality due to diabetes, Sub-Saharan Africa, 2015



Source: International Diabetes Federation. Diabetes Atlas. 2015[45]

1.2.2.3. Hypercholesterolemia

Hypercholesterolemia (also called dyslipidemia) is a condition characterised by high levels of total cholesterol in the blood. Total cholesterol comprises four components, classified by their density: very low-density lipoprotein; low-density lipoprotein (LDL); intermediate density lipoprotein, and high-density lipoprotein (HDL).[54]

All lipoproteins carry cholesterol, but elevated levels of lipoproteins other than HDL, particularly LDL, are associated with an increased risk of atherosclerosis and coronary heart disease.[55] In contrast, higher levels of HDL cholesterol are beneficial, as HDL carries cholesterol away from the arteries back to the liver for excretion.[56] Elevated levels of total and LDL cholesterol, as well as low HDL cholesterol, are widely documented as risk factors for CVDs.[55,57,58] The female sex hormone oestrogen tends to raise HDL cholesterol levels, which may help explain why premenopausal women are relatively protected from developing coronary heart disease.[56,58]

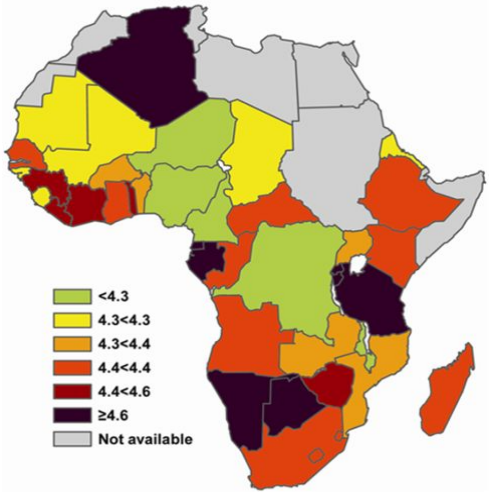
Treatment with lipid-lowering drugs (particularly statins) enables an effective reduction in LDL, and therefore total cholesterol levels, with resulting reductions in CVD incidence, deaths and overall mortality.[21,59] Cholesterol reduction is beneficial in both primary and secondary prevention of MI and strokes and is currently recommended for all people with histories of these conditions, as well as those with a ten-year CVD risk of 20% or more.[21,60]

Hypercholesterolemia is conservatively defined as a level of 240 mg/dL or more of total cholesterol in the blood.[21,61] Some guidelines point to a value of total cholesterol less than 190 mg/dL; however, there is no evidence of an ideal target level of cholesterol. The current guideline is to maintain the lowest possible levels of cholesterolemia, particularly in patients with the highest total risk of cardiovascular events, in which the greatest benefit from statin therapy can be obtained.[21,61]

In 2015, high total cholesterol was responsible for 7.1% of deaths worldwide in both sexes, while in SSA, it was only connected with 1.7% of deaths.[17] This low value could be caused by the difficulties in determining values of blood cholesterol in African communities because of the high cost of laboratory tests.

For example, from 30 surveys conducted between 2004 and 2012, following the WHO stepwise approach to chronic disease risk factor surveillance (STEPS) in SSA, only 14 reported values of prevalence for hypercholesterolemia. These results varied from 2.1% in Mozambique to 26.0% in Tanzania.[62] The mean value of total cholesterol presents a high heterogeneity across Africa (Figure 6). Despite the difficulties, a value of 4.08 mmol/L for men and 4.27 mmol/L for women, the lowest value worldwide, was determined for the serum total cholesterol in 2008 in SSA.[63]

Figure 6. Estimated Mean Total Cholesterol (mmol/L), both sexes, age ≥15 years, 2010



Source: Adapted from Silwa et al. Circulation, 2016. [64]

The percentage of people with raised blood cholesterol who are effectively treated remains small worldwide, and many of those affected are unaware of their condition.[61] This problem raises the concern for the SSA region, where the general population is not alerted to NCDs.

1.2.2.4. Tobacco

Smoking is the most common way tobacco is consumed worldwide.[65] Cigarette smoke contains more than 7000 chemicals, including nicotine (which creates dependence), reactive oxygen and nitrogen species, carbon monoxide, nitric oxides, cadmium, polycyclic hydrocarbons, and other metals and oxidants. Some of these chemicals are well established as toxic and carcinogenic.[65]

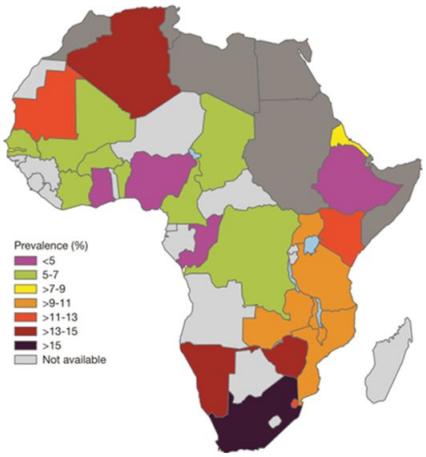
Even in low consumption levels or passive smoking, smoking is one of the strongest lifestyle behaviours associated with the risk of CVDs.[21,22,25] Smoking damages the endothelium lining of the blood vessels, increases cholesterol plaques and clotting, raises LDL levels and lowers HDL, and promotes coronary artery spasm. Nicotine accelerates the heart rate and raises blood pressure.[66] Women smokers have a higher risk of MI than male smokers.

There is strong evidence that proves the beneficial effect of smoking cessation on coronary heart disease mortality. However, the magnitude of the effect and the time required to achieve beneficial results are unclear.[21,22] The benefits of no longer smoking to health are clear, but the most effective strategy to encourage cessation is not clearly established.[21,66]

Tobacco presently accounts for 7 million deaths annually,[17] projected to increase to 8 million by 2030.[1] Between 1980 and 2012, global estimates showed a decreasing trend of smoking in both sexes: 967 million smokers lived in 187 countries in 2012. Despite this decrease in prevalence, the total number of smokers is expected to increase as the population grows.[66] It is estimated that close to 80% of the people who smoke tobacco in the world are from LMICs.[67]

In 2015, tobacco smoke was responsible for 3.8% of deaths in SSA (the seventh cause of mortality in both sexes), with a rise in the number of attributable deaths from 240 thousand in 1990 to 300 thousand in 2015.[17] Generally in SSA, the prevalence of smoking among women is much lower than among men,[68] with a vast heterogeneity between country estimates.[62,68] Figure 7 illustrates this heterogeneity and reveals considerable missing national data, including Angola.

Figure 7. Age-standardized prevalence estimate for smoking (%), both sexes, age ≥15 years, 2006



Source: Adapted from Silwa et al. Circulation, 2016. [64]

1.2.2.5. Overweight and obesity

Overweight and obesity are defined as abnormal or excessive fat accumulation.[1,69] The body mass index (BMI), a person's weight (in kilogrammes) divided by the square of their height (in metres), is a crude population measurement used to define people's "weight category". A person with a BMI of 25 kg/m^2 or more is considered overweight, and one with a BMI of 30 kg/m^2 or more is obese.[69]

Overweight and obesity are major problems for global public health because they are strongly related to raised blood pressure, type 2 diabetes and hypercholesterolemia, all know cardiovascular risk factors. A weight-reducing diet, combined with exercise, produces significant weight loss, reduces cholesterol and improves control of blood pressure and diabetes.[1,21,22,69,70]

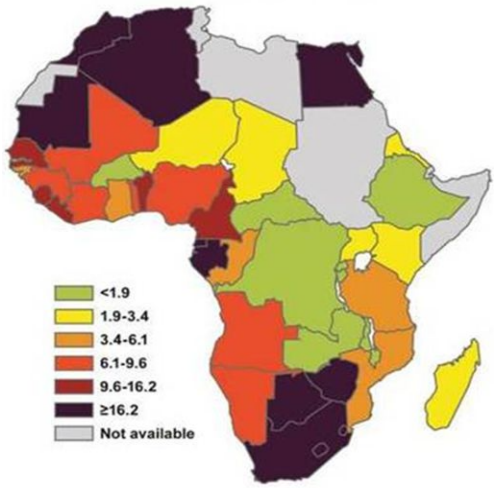
Between 1980 and 2013 the proportion of adults with overweight and obesity increased worldwide, from 28.8% to 36.9% in men and from 29.8% to 38.0% in women. This phenomenon was observed in all regions of the world.[71] This global occurrence is related to poorer populations moving up in the income scale, shifting from traditional diets to western diets and moving from subsisting to overeating, transforming obesity in the past decades into a pandemic across developing countries.[72]

However, underweight (BMI less them 18 kg/m^2) remains an important social and health threat in the poorest parts of the world. Associated with increased risk of morbidity and mortality,[70-73] underweight is only slowly decreasing in Africa.[74] This paradox of obesity rates

rising and underweight persisting is referred as ‘nutrition transition’ and sometimes can occur within the same household.[75]

Historically under-nutrition has received more attention in SSA than over-nutrition; thus, nationally representative studies of obesity in SSA are scarce. The available studies, however, suggest that obesity rates vary widely from country to country,[70,71,74] as evidenced in Figure 8.

Figure 8. Prevalence of obesity (%), both sexes, age ≥15 years, 2005



Source: Adapted from Silwa et al. Circulation, 2016. [64]

In 2015, a high BMI was the tenth leading factor of death in SSA with 3.3% in both sexes, rising from the 14th risk factor in 1990.[17] This rise in obesity was not followed by proper treatment or prevention measures, creating a higher prevalence of obesity across SSA in urban areas, among the poorest individuals, less educated people and females.[76,77] Urbanisation, sedentary lifestyles and nutritional changes towards westernised diet, high in sugar and fats, are leading to an increased obesity prevalence that coexists with the burden of communicable diseases.[11-15]

1.2.3. Socioeconomic risk factors

The drivers of the behaviours that cause the rise in prevalence of some modifiable risk factors are connected with individuals' socioeconomic conditions, like education level, area of residence (i.e., rural or urban settings) and economic power. These conditions gain particular interest in LMICs since they set a different context than that of high-income countries, where the majority of CVD research is conducted.

Individuals of low socioeconomic status generally experience a higher burden of risk factors. However, the direction of the association between socioeconomic status and behavioural risk factors may have changed in the last decades. Unhealthy behaviours were more frequent in high socioeconomic groups at the beginning of the 20th century, but the burden later shifted towards the disadvantaged socioeconomic groups in high-income countries,[78] breaking the paradigm that CVD is a "disease of affluence" in high-income societies or a "western disease" when comparing world regions.[79]

The situation is less clear in LMICs due to the scarcity of data. A recent systematic review and the World Health Survey identified that individuals of low socioeconomic status in LMICs were more likely to use tobacco and alcohol and to have less healthy diets, whereas individuals of high socioeconomic status tended to be more physically inactive.[80,81]

1.2.3.1. Education

Education has been used as a measurable marker of the relationship between socioeconomic status and adverse health effects and has been reported as an important predictor of CVDs.[36,82,83]

Usually in high-income countries, relative risk increases progressively from patients in the most educated class to those in the less educated,[82] but this is not necessarily true in LMICs. In a study conducted in 44 countries, a higher education level was not protective against cardiovascular events in LMICs, particularly in women.[83] In a systematic review that assessed the association between socioeconomic status and obesity in LMICs, individuals with higher educational attainment were more likely to be obese.[84]

In the INTERHEART Africa study, among the Black population, those who had less than eight years of schooling, as opposed to those with higher educations, showed an increased risk of acute myocardial infarction. The direction of association was the opposite for the

European and other African groups. In these groups, those with tertiary education had a significantly lower risk.[36]

These differences between results from high-income and LMICs highlights the need for further studies that consider the socio-demographic patterning of risk factors, allowing a better characterisation of the social distribution of health and for planning prevention programs.

1.2.3.2. Urbanisation

The world has become more urban in the last century. Today, more than half of the world's population lives in cities, compared to 10% in 1900 and 30% in 1950.[85] Africa still remains mostly rural, with 40% of its respective populations living in urban areas. The rate of urbanisation in Africa is expected to be faster than the other regions and is projected to become 56% urban by 2050.[85] Countries where most of the population is rural are seeing urbanisation progress quickly, with a constant passage of young people from the rural areas seeking education and work in urban areas.

In many LMICs, new urban areas develop so quickly that health and education infrastructures do not have time to develop,[85,86] worsening the effects of urban food and built environments, as well as the new technologies that accompany city living that lead to poorer diets (increased intake of energy-dense foods and high-calorie sugary meals and drinks), more sedentary lifestyles and less energy-demanding jobs.[11,86,87]

The effects of urbanisation on CVDs is well established in published literature.[87] The modifiable risk factors for CVDs (e.g., smoking, hypertension, and obesity) may be exacerbated by city living and its decreased availability of safe, green space for exercise and recreation, increased pressures from mass marketing and the availability of cheap but unhealthy food options.[87] A study from South Africa suggests that future MI risk may be higher amongst affluent Black South Africans as exposure to urban dietary trends occurs. The "westernisation" of the traditional diet increases the dietary intake of fat and animal protein, leading to increases in LDL cholesterol levels of men and women.[88]

1.2.3.3. Income level

Income level is one component in an individual's socioeconomic status. The country's economic development, measured by the Gross Domestic Product (GDP) per capita, is also used as predictor of CVD risk factors.[79] In a cross-national analysis of 85 countries, a concave and nonlinear association between GDP per capita, mean BMI and serum cholesterol, with higher risk factor levels at intermediate (versus low) GDP levels and comparable to slightly lower risk factor levels at high (versus intermediate) GDP levels, was found.[79]

Regarding cross-country associations of income inequality with CVDs and risk factors, income inequality is likely to have an effect on cardiovascular risk factors. Higher income inequality was related to higher mean SBP in both sexes, and positive associations were observed between higher income inequality and mean BMI, obesity prevalence and MI mortality rates.[89]

The influence of an individual's income level depends on the national GDP. Although income level and weight have a positive association in low-income countries, they have a negative association in high-income countries.[83,90] These relationships and their causes need to be tested in larger and more diverse national studies in LMICs, especially in Africa where the cultural aspects and the shifting demography are important roles in the contextualisation of health and wealth relations.

1.3. Health policies for cardiovascular disease prevention

As discussed earlier, CVDs and associated risk factors and their prevention, management and control are major global health issues, involving public officers, clinical researchers, epidemiologists and patients. Being part of the larger group of NCDs, CVDs share the same risk factors and interventions.

Significant health gains in cardiovascular health can be made through public health and treatment interventions that have an impact on large segments of the population. Much of these approaches were used in high-income countries, but the challenge of adapting the knowledge acquired to halt and reduce the burden of CVDs in LMICs remains.

1.3.1. Health promotion and system approach

For successful prevention, control and cessation of the CVD epidemic, changes are needed in health policies, legislation and taxation. All of these also require public understanding, support and demand, allied to an international strategy of knowledge and solution sharing. Thus, global health initiatives were created in the last decade, with a strong involvement of governments, health professionals, researchers and patient associations.

The most cost-effective methods for reducing CVD incidence involve population-wide efforts to reduce modifiable risk factors through multiple economic and educational policies and programs, like:

- food labelling for nutritional content;
- educational programs to promote decreased consumption of fats, sugars, sodium and alcohol;
- tobacco use targeting and penalization;
- and campaigns advocating regular physical activity for weight reduction and control.[4]

The first international convention related specifically to CVDs is the WHO Framework Convention on Tobacco Control that began in 2005.[91] Currently, with 180 countries, this global agreement provides the basis to implement and manage tobacco control on a worldwide scale, using the MPOWER measures to assist and monitor evolution. In 2015, more than half the countries had implemented at least one MPOWER measure at the highest level of achievement.[91] Despite the fact that raising tobacco taxes to more than 75% of the retail price is among the most efficient and cost-effective tobacco control interventions, only a few countries have increased tobacco taxes to the best practice level.[91]

Following the Political Declaration on NCDs adopted by the United Nations General Assembly in 2011, the WHO developed a global monitoring framework to enable global tracking of progress in globally preventing and controlling the four major NCDs (CVDs, cancer, chronic lung diseases and diabetes) and their key risk factors.[1,3,4]

This framework took the form of the WHO Global action plan for prevention and control of NCD 2013–2020 (known as the Global NCD Action Plan).[4] Nine global targets and 25 indicators where defined, highlighting the importance of prioritizing country action to reduce harmful use of alcohol, insufficient physical activity, salt/sodium intake, tobacco use and hypertension; halt the rise of obesity and diabetes; and improve coverage of treatment for prevention of MI and strokes and access to basic technologies and medicines.[4]

These voluntary global targets are aimed to fight global mortality from NCDs, accelerating action against the leading risk factors and strengthening national health system responses. The mortality target, a 25% reduction in premature mortality from NCDs by 2025, was adopted by the World Health Assembly in 2012.[1,3,4] Some concerns have been raised by researchers, if the correct trend persists, that no WHO region will meet this goal.[2,38]

Before this framework and global strategy, the WHO developed a surveillance and epidemiological system that allowed countries with poor resources to find evidence on NCDs adapted to their needs and available resources. The WHO-STEPS focuses on obtaining core data on the traditional risk factors that underlie the NCD burden. This system was designed to be flexible, allowing each country to obtain data on the core variables and risk factors and to expand to optional modules based on state interest, need and resources. The use of the same standardised questions and protocols enables appropriate comparisons across countries.[92]

There are currently two STEPS surveillance systems, the STEPwise approach to risk factor Surveillance and the STEPwise approach to Stroke Surveillance. The three key steps of the survey tool are the collection of basic demographic, behavioural and lifestyle factors; physical measurements, such as height, weight and blood pressure; and biochemical assessments, including fasting blood glucose and blood cholesterol.[92]

Even with these knowledge structures and policy frameworks, the improvements in prevention and treatment that led to decreases in CVDs in many high-income countries do not occur in many other parts of the world where the burden is greatest. For that, the WHO create technical packages to strengthen NCD management, which complement WHO strategies, and packages for population-based primary prevention of CVD, including tobacco control and salt reduction.[93]

One recent tool, launched in 2016, is the technical package HEARTS.[94] Aimed to prevent CVDs by ensuring equitable access to continuous, standardised high-quality care for people at high risk, HEARTS provides a set of effective, practical interventions for strengthening the management of risk factors for CVDs in primary health care.[94] This package covers six key elements: healthy lifestyle, evidence-based treatment protocols, access to essential medicines and technology, risk-based management, team care and task-sharing, and systems for monitoring.

1.3.2. Cardiovascular risk prediction and individual approach

Although public approaches have an important role in the fight against CVDs, the final solution to this problem resides in the individual capacity and will to change unhealthy behaviours (primary prevention) and enlist in the proper treatments to reduce the needed risk factors or recurrence of CVDs (secondary prevention). For this, governments need to secure the proper health education for individuals, as well as increase the availability of drugs and medical facilities: the two major issues in developing countries.

Risk factors often cluster together, and the number of risk factors and their co-occurrence are directly related to the incidence of CVDs.[22] To understand an individual's risk of CVD, it is important to realise an individual's 'global risk' of developing the condition.[4,21,22] Usually, this involves the determination of the ten-year risk of developing a CVD.

The WHO and the International Society of Hypertension (ISH) created a risk prediction chart[21] that can be applied in different regions and settings. This approach is more cost effective than other approaches that only make treatment decisions based on individual risk-factor thresholds (e.g., hypertension, hypercholesterolemia).[22,93]

This risk prediction methodology aligns with the more 'holist' approaches, which integrate non-pharmaceutical lifestyle modifications into the use of medicines, like aspirin, blood pressure modification, statin medication for hypercholesterolemia and specific medications to regulate blood glucose. Also, some intensive techniques are employed in patients with CVDs, such as coronary stenting and coronary artery bypass grafting for ischemic heart disease and thrombolytics for cerebrovascular disease.

One suggested approach to individual care is the ABCDE, a straightforward and organised guide for consistent, comprehensive management of cardiovascular risk in daily clinical practice.[95] This suggestion from the American College of Cardiology integrates lifestyle interventions with drug therapy and consists of an assessment of risk and antiplatelet therapy, blood pressure management, cholesterol management, cigarette/tobacco cessation, diet and weight management, diabetes prevention and treatment, and exercise.[95]

Even if some of the proposed methodologies cannot be easily applied due to the steady supply of drugs, changes to personal lifestyle can be encouraged, with good results in the decrease of the global cardiovascular risk.

1.4. Cardiovascular diseases in Africa: from epidemiology to intervention

The epidemiological study of CVD is a common practice among high-income societies. First started in the 1950s and based on observational prospective studies with steady cohorts and follow ups over decades, this study has progressed in recent years to interventional studies.[96] This natural evolution is due to the need to assess whether the presence of risk factors not only predict clinical outcomes, but also whether their control and reduction causes a decline in the risk. However, CVD research in SSA has been negligible, with the majority of published studies conducted at hospital services, not in the general population.[97,98]

In continental Africa, particularly in SSA, the majority of countries are classified as low- or middle-income, sharing with other regions of the world the same lack of health and research infrastructures that allow knowledge of and intervention into the real burden of CVD. With the adoption of the World Health Organisation's "Global Action Plan for the Prevention and Control of non-communicable diseases, 2013-2020", global awareness for this problem is rising.[4] One of the pillars of this global plan is the need for a national dimension of risk factors for CVDs (and other NCDs) reporting on a regular basis.[3,4]

The distribution of CVDs and their risk factors is heterogeneous across SSA but high in some settings, creating a heavy burden on the already weakened infrastructures of the region. Because of the lack of vital statistics systems, larger epidemiologic studies with a variety of designs (cross-sectional, longitudinal and interventional) can assist in the analyses of trends and the definition of patterns. This can provide a better understanding of such diseases and inform health-care policy to mitigate the CVD burden.[97]

Cardiovascular diseases in SSA can no longer be ignored or left behind the communicable diseases in the research and health intervention agenda, but must be integrated with them.[98,99,100] Without setting these areas aside, there is an opportunity to use structures that are already in place to maximize resources. The international community should consider expanding the mandate of current programs to include outcome-oriented measures for improving general health and lifestyles.[100] For example, inadequate diet in early life may result in sensitivity to the lifestyle-related risk factors of CVD.[99] In LMICs, where undernutrition is addressed in the maternal and child health programmes, there is an opportunity for joint efforts to tackle both group of diseases.

There is a need for health system reform to strengthen primary care as a major policy to reduce the toll of CVDs.[99] The consequent increase of diagnoses of CVDs will lead to a

corresponding need for health service capacity, which is currently over-stretched.[97] The implementation of aggressive primary prevention programmes, without proper evaluation of priorities, can lead also to poorer health outcomes.[97]

The social patterning of CVDs in LMICs needs to be framed along two perspectives, bearing in mind the availability of data and specific national contexts. The first perspective is the definition of the current pattern based on reliable population-based epidemiological data; the second is the detection of the potential relevance of different scenarios of CVD social patterning on policy development, using translational tools to anticipate future trends (e.g., findings in high-income countries).[101]

Angola has no national surveillance system for NCDs, and periodic local population-based studies can help overcome the lack of information.[97,102] The main purpose of this thesis's research plan is the implementation of a study protocol that will collect information on risk factors, awareness, treatment and control rates, and prevalence of symptoms relevant to CVD to assist decision makers in the implementation of prevention and treatment policies and programs.

2. Aims

Surveillance on CVDs and corresponding risk factors is essential to obtain an accurate characterization of their frequency and distribution over time, as well as to understand and predict the trends of such diseases. Therefore, the general purpose of this research project was to contribute to a better understanding of the epidemiology of CVDs risk factors in Angola, through the study of an adult Angolan community.

For this purpose, a study protocol named CardioBengo was designed and implemented, creating a baseline and proposing a follow-up strategy to address the surveillance of risk factors (as reported in Paper I), in addition to a follow-up to a previous hypertension survey conducted in 2011 in the same population.[103]

This thesis focuses specifically on the characterization of hypertension, diabetes, hypercholesterolemia, tobacco consumption and body mass index (BMI) categories in this population. We also aimed to analyse the awareness, treatment and control of hypertension, diabetes and hypercholesterolemia and to assess the clustering of these risk factors, proving additional data for the planning of future interventions.

Therefore, this thesis includes reports that correspond to the following specific objectives:

a) Estimate the incidence of hypertension in the last two years and the association with socio-demographic, anthropometric and behavioural characteristics (Paper II);
b) Quantify the prevalence, awareness, treatment and control of hypertension, diabetes and hypercholesterolemia and the association with socio-demographic, anthropometric and behavioural characteristics (Paper III);
c) Describe the tobacco consumption and its relationship to socio-demographic characteristics, and determine the nicotine level of dependence (Paper IV);
d) Quantify the prevalence of body mass index categories and evaluate its relationship with socio-demographic characteristics (Paper V);
e) Estimate the distribution of the population by cardiovascular risk categories and its eligibility for pharmacological treatment (Paper VI).

3. Methods

The aims of this thesis were accomplished through the analysis of data from a community-based survey, CardioBengo, designed and first implemented for this purpose. Furthermore, a parallel follow-up of a population previously studied in the same region was conducted.

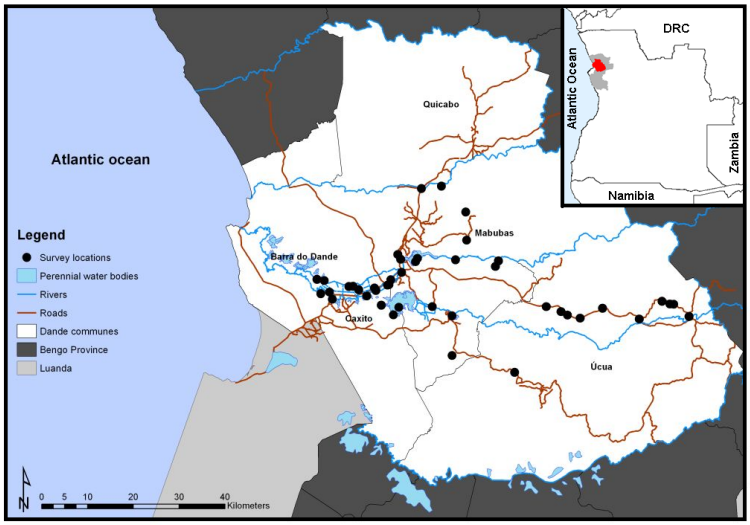
The CardioBengo protocol is based on the STEPS guidelines, covering more variables than the ones covered by this thesis, and thought of as a surveillance sentinel system for CVD monitoring. The work treated in this thesis is the baseline approach to the main CVD risk factors, which along with the follow-up of a previous sample, constitutes the first attempt to create and test the implementation of a cohort in this setting.

A general description of the study site, participants, data collection and methodological issues is provided below. The selection of participants eligible for each analysis, the definition of variables and the statistical analysis depended on each specific objective, therefore described in detail in the published papers (Sections 4.1 to 4.5).

3.1. Study site and population

This study was conducted in the catchment area of the Centro de Investigação em Saúde de Angola (CISA), which includes the Dande Health and Demographic Surveillance System (Dande-HDSS). The Dande-HDSS monitors the structure, dynamics and geographical distribution of a population of 60,075 people, spread across 4,737 km^2 and covering three communes (Caxito, Mabubas and Úcua) of the Dande Municipality in the Bengo Province (Figure 9),[104,105] 60 km north of Luanda, the capital of Angola.

Figure 9. Dande - Health and Demographic Surveillance System Area



From the 69 hamlets in the Dande-HDSS, 26 are classified as urban areas (i.e., capitals of provinces or municipal headquarters, having agglomerations of 2,000 or more inhabitants and basic infrastructures) where the majority of the population lives (77%).[104,105]

The median age within the Dande-HDSS is 19 years old, aligned with the predominance of young people, and the reduced number of elderly individuals: 41% are under 14 years old, 55.5% are between 15 and 64 years old (33,342 individuals), and only 3.6% are 65 or over.[15] Women represent 55.1% of the age group between 15 and 64 years old, which rises to 61.6% in the 65 or over population.[104,105]

The Bengo province is the lesser-populated province of Angola (only 1.4% of 25.8 million total inhabitants). The Dande-HDSS reflects the national demographic structure made in 2014 that also points to a young population (only 2.3% are 65 years old or over) with 50.3% between 15 and 64 years old; 51.5% are females, and 68% of the population is concentrated in urban areas.[106]

3.2. Study design and participants

3.2.1. Incidence of hypertension

A prospective longitudinal study was conducted from a baseline of 1,464 individuals older than 18 years, recruited from the Dande-HDSS and evaluated from 11 October to 20 December 2011.[103] From 18 September to 20 December 2013, participants without hypertension at the baseline were approached and offered a new evaluation (Section 4.1). This work was integrated into the cross-sectional community-based survey (Section 3.2.2.), and the same data collection protocol was applied.

3.2.2. Prevalence of risk factors

A cross-sectional community-based survey, CardioBengo, was designed and first implemented to serve as a new baseline of the prevalence of risk factors among individuals between 15 and 64 years old (Section 3.3). From September 2013 to March 2014, 3,515 individuals were contacted. Of these, we were able to examine 2,484 individuals: 750 (21.3%) were unreachable, and 281 (8.0%) refused to participate. The sum of these values approaches the predicted nonparticipation rate of 30%, assumed in the representative sex- and age-stratified random sample calculated for this research (Section 3.3).

3.3. Paper I - CardioBengo Study Protocol

Pedro JM, Rosário E, Brito M, Barros H.

CardioBengo study protocol: a population based cardiovascular longitudinal study in Bengo Province; Angola

BMC Public Health. 2016;16: 206. doi: 10.1186/s12889-016-2759-9

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DOI 10.1186/s12889-016-2759-9

BMC Public Health

STUDY PROTOCOL Open Access

CardioBengo study protocol: a population based cardiovascular longitudinal study in Bengo Province, Angola

João M. Pedro[1,2*], Edite Rosário[1], Miguel Brito[1,3] and Henrique Barros[2,4]

Abstract

Background: Cardiovascular diseases and other non-communicable diseases are major causes of morbidity and mortality, responsible for 38 million deaths in 2012, 75 % occurring in low- and middle-income countries. Most of these countries are facing a period of epidemiological transition, being confronted with an increased burden of non-communicable diseases, which challenge health systems mainly designed to deal with infectious diseases. With the adoption of the World Health Organization "Global Action Plan for the Prevention and Control of non-communicable diseases, 2013–2020", the national dimension of risk factors for non-communicable diseases must be reported on a regular basis. Angola has no national surveillance system for non-communicable diseases, and periodic population-based studies can help to overcome this lack of information. CardioBengo will collect information on risk factors, awareness rates and prevalence of symptoms relevant to cardiovascular diseases, to assist decision makers in the implementation of prevention and treatment policies and programs.

Methods: CardioBengo is designed as a research structure that comprises a cross-sectional component, providing baseline information and the assembling of a cohort to follow-up the dynamics of cardiovascular diseases risk factors in the catchment area of the Dande Health and Demographic Surveillance System of the Health Research Centre of Angola, in Bengo Province, Angola. The World Health Organization STEPwise approach to surveillance questionnaires and procedures will be used to collect information on a representative sex-age stratified sample, aged between 15 and 64 years old.

Discussion: CardioBengo will recruit the first population cohort in Angola designed to evaluate cardiovascular diseases risk factors. Using the structures in place of the Dande Health and Demographic Surveillance System and a reliable methodology that generates comparable results with other regions and countries, this study will constitute a useful tool for the surveillance of cardiovascular diseases. Like all longitudinal studies, a strong concern exists regarding dropouts, but strategies like regular visits to selected participants and a strong community involvement are in place to minimize these occurrences.

Keywords: Cardiovascular risk factors, Incidence, Prevalence, Epidemiology, Angola, Sub-Saharan Africa

Background

Cardiovascular diseases (CVDs) are a leading cause of death. In 2012 they were responsible for 17.5 million deaths worldwide, and along with other non-communicable diseases (NCDs) such as cancers, chronic respiratory diseases and diabetes they constitute by far the major causes of death that year. Around 75 % (28 million) of those deaths happened in low- and middle-income (LMI) countries. Of the 16 million of deaths caused by NCDs before the age of 70, 82 % took place in those countries [1].

CVDs and other NCDs share common risk factors such as obesity, hypertension, hyperglycaemia or hypercholesterolemia, smoking, physical inactivity, unhealthy diets or alcohol [1, 2]. NCDs behavioural risk factors are commonly associated with life styles whose consequences usually manifest at older ages in high-income countries. However, in the LMI countries NCDs are

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rising faster and affecting younger people, therefore presenting earlier those consequences of adverse health and economic outcomes [3, 4].

The growing burden of NCDs with their associated premature mortality, are a major concern for health systems decision-makers, especially in developing countries, were NCDs growth outpaced the reduction in communicable diseases by 33 % between 1990 and 2010 [3]. The "Global Action Plan for the Prevention and Control of NCDs, 2013–2020" adopted by all member states of the World Health Organization (WHO) defined nine voluntary global targets to be achieved by 2025, one being a 25 % reduction from 2010 levels in NCD related preventable deaths (referred to as the 25x25 target) [5]. All signatories have committed to report national levels of NCD risk factors on a regular basis, reinforcing the key recommendations of the 2011 United Nations high-level meeting on NCDs which included the strengthening of surveillance of NCD [6], that allows a global and integrated mechanism to support the implementation of prevention and treatment policies and programs.

The WHO STEPwise approach to Surveillance (STEPS) was designed in 2007 to provide core data on the established risk factors for the major NCDs based on standardized questions and protocols that enable appropriate comparisons across surveys. It uses a modular technique, which allows to fit the specific needs and the available resources for each setting [7].

STEPS was used in 36 African countries, between 2003 and 2013 [8], but not in Angola where four studies conducted between 2008 and 2014 provided the available information on CVDs risk factors using other methodologies: a survey in 667 adult students of Health Sciences in Lubango, south of the country [9]; a study conducted in 615 active employees of a public university in Luanda, the capital of Angola [10]; a survey with 421 subjects from a rural community near Luanda [11]; and a community-based survey with 1464 participants conducted by the Health Research Centre of Angola (CISA) in the catchment area of the Dande Health and Demographic Surveillance System (Dande-HDSS) [12].

Using the Dande-HDSS structure for data collection and management setting, we designed a new study, named CardioBengo, to address the surveillance of the major CVD risk factors with special emphasis on the agreed selected NCD risk factors: tobacco use, harmful alcohol use, salt intake, obesity, raised blood pressure, raised blood glucose and diabetes and physical inactivity but also covering the additional targets that focus on treating people at high risk of heart attack and stroke and on the availability of drugs to treat NCDs. Accordingly, the study aimed to:

- Quantify the prevalence, awareness, treatment and control of hypertension, hyperglycaemia and hypercholesterolemia and their socio-demographic and behavioural determinants, as a baseline for future assessments;
- Describe tobacco, alcohol consumption, physical activity and diet patterns;
- To run follow-up assessments every 3 years, to monitor and understand trends in risk factors and outcomes frequency.

Methods

Study design and setting

CardioBengo is a research to be conducted in the catchment area of the Dande-HDSS, located in the Dande Municipality, Bengo Province, 60 km north of Luanda, the capital of Angola. Dande-HDSS monitors the structure, dynamics and geographical distribution of a population of 60,075 people (53.5 % adults) that spreads across an area of 4700 km^2 with 70 hamlets across three communes (Caxito, Mabubas and Úcua) [13]. This HDSS constitutes the base for the identification of a representative population sample to be invited to participate in the cohort providing a baseline assessment and a longitudinal follow-up evaluation planned at every 3 years, taking the same approach used at baseline.

Sample size estimation and sampling

The sample size is calculated assuming a simple random sample, based on the 23 % prevalence of hypertension found for this population in a study conducted in 2011 [12], and anticipating a response rate of 70 %. The sample size estimates were generated for males and females in five age groups between 15 and 64 years old, resulting in a total of 3515 individuals. A random list will be drawn from the Dande-HDSS population database.

Inclusion and exclusion criteria

The inclusion criteria are: i) living in the Dande-HDSS study area at the time of the field work, ii) willingness to participate in this study, and iii) age between 15 and 64 years. The exclusion criteria are: i) subjects with missing anthropometric or blood pressure values and ii) pregnant women; because their biochemical and anthropometric parameters would vary from the non-pregnant physiology they will be excluded from the baseline analysis.

Pilot study

A pilot study was conducted to test data collection instruments, procedures and to improve the training of field workers. Adjustments in the language used in the questionnaires were made, and the field logistics optimized to a model of five testing protocol stations,

namely i) registry and socio-demographic data, ii) point of care clinical tests, iii) anthropometric measures and food habits, iv) blood pressure measurement and drug treatment history and v) electrocardiogram, for the field work facilities. The median time for each participant to pass through all five stations was calculated in 2 h, reaching to the conclusion that a maximum of 25 participants in an 8 h day's work is possible. All field workers and health professionals selected to collaborate in the study were involved on the pilot study and their skills tested and improved, if necessary.

Enrolment of participants

One day before the arrival of the team that will implement all the procedures related with the protocol, a field worker visits the hamlets in order to prepare the necessary arrangements for the field work, namely engaging with the local authorities, involving them in the process of selection of an adequate location to install the study facilities and in the door-to-door contact of the prior selected participants, in order to sensitize them to the objectives of the study and to schedule their participation for the next days.

Selected individuals will be consider unreachable after 2 failed attempts of contact in their household at different hours in weekdays, and a refusal will be recorded when the contacted person explicitly says that he or she doesn't want to participate.

Each participant is expected to spend up to two hours to complete the study tasks, receiving a small lunch at the end, in order to compensate the fasting period previous to the exams. After the exams all participants will receive a card summarizing their clinical and anthropometric results and those with abnormal levels of blood pressure, glucose, cholesterol or other clinical alteration will be referred to the General Hospital of Bengo for a follow-up evaluation with a medical doctor.

Study procedures

All procedures will be conducted by trained interviewers from the Dande-HDSS and certified health professionals (nurses, laboratory technicians and cardiopneumographic technician) able to communicate in Portuguese (official language) and in the local languages. The protocol for data collection is based on the WHO STEPS manual version 3.0 [7], translated to Portuguese, pretested and piloted as referred above. All core items are included and some of the expanded items adapted to the specific context.

Demographic and social characteristics

Information on age, sex, marital status, current occupation, completed years of school frequency and household income will be obtained using a questionnaire following the STEPS manual [7].

Behavioural measurements

Information on smoking, namely current smoking status and number of cigarettes smoked, will be collected as described in the STEPS manual [7]. Additionally, a validated Portuguese version of the Fagerström test [14], is used to assess smoking dependency. Alcohol intake, the daily consumption of fruit, vegetables and oil or fat, will be measured according STEPS manual [7]. The optional module for dietary salt is also included in the questionnaire [7]. Physical activity and sedentary behaviour will be assessed using all core and expanded items of the STEPS manual [7].

Medication history

Following the STEPS guidelines [7], the history of eachindividual regarding hypertension, hyperglycaemia and hypercholesterolemia, is obtained through questions evaluating previous measurements of high blood pressure, glycaemia and blood cholesterol. When any of these items are identified as positive, the participants will be asked about history of recommendations or degree of awareness of such conditions transmitted by a health professional. Any individual will be considered under treatment if he/she indicates the use of specific drug therapy and considered controlled if he/she presents a normal measurement under a specific drug therapy.

Female reproductive history

Data will be collected on menarche, reproductive history (number of pregnancies and outcomes), pregnancy induced hypertension, menopause and contraception methods used.

Clinical and anthropometric assessments

Physical exams will be performed with individuals wearing light clothing, with no footwear and after an overnight fast. For all participants, fasting conditions (more then eight hours without eating) will be recorded. Waist and hip circumferences will be measured to the nearest 0.1 cm using circumference tape SECA 203 (SECA United Kingdom, Birmingham, UK). Body weight will be measured to the nearest 0.1 kg using a digital scale SECA 803 (SECA United Kingdom, Birmingham, UK). Height will be measured to the nearest 0.1 cm in the standing position using a portable stadiometer SECA 213 (SECA United Kingdom, Birmingham, UK). Body mass index and waist to hip ratio will be calculated and categorized according WHO guidelines [15, 16]. Blood pressure will be measured using the automatic sphygmomanometer OMRON M6 Comfort (OMRON Healthcare Europe B.V., Hoofddorp, The Netherlands), as recommended [17]. Each participant will rest for 15 min before measurements: seated, at the right arm, with an appropriate cuff size and 3 readings done at 3 min intervals. An electrocardiogram and rhythm strip will be recorded

from all participants using a 12-channel electrocardiograph AsCARD Mr.Grey V 201 (ASPEL, Zabierzów, Poland), that will be recorded digitally using the data base software CARDIO TEKA v001 (ASPEL, Zabierzów, Poland). Respecting the right to privacy of the participants, the electrocardiogram will be conducted in the most private manner behind close curtains.

Biological sample collection

Blood sugar will be measured using a blood glucose meter ACCU-CHEK Aviva (Roche Diagnostic, Indianapolis, IN, USA) with ACCU-CHEK AVIVA Glucose reactive strips (Roche Diagnostic, Indianapolis, IN, USA). Total cholesterol on the blood will be measured only for participants with more then eight hours fasting, using a point-of-care device ACCUTREND Plus (Roche Diagnostic, Indianapolis, IN, USA) with ACCUTREND CHOLESTEROL reactive strips (Roche Diagnostic, Indianapolis, IN, USA). A urine sample will be collected for assessment of urinary creatinine and microalbumin using test strips AUTION SCREEN (Arkray Europe, Amstelveen, The Netherlands). Finger-prick blood samples will be collected and spotted onto Whatman™ 3MMChr filter paper (Fisher Scientific, Pittsburgh, PA, USA). Blood spots on filter paper will be left to air dry and them stored at 4 °C.

Referral of participants with clinical alterations

All participants with abnormal clinical results will be referred to the General Hospital of Bengo for a medical visit. A specific form was designed to follow clinical characteristics and treatment prescriptions. The adherence to treatment is evaluated according Morisky Medication Adherence Scale of 4 items [18].

Future study waves

It's expected to follow-up the cohort every 3 years using the same protocol, enabling the identification of trends and associations between risk factors and outcomes.

Using the Verbal Autopsy System of the Dande-HDSS adapted from the WHO standardized form [19], data will be crossed and deaths of individuals in this cohort can be identified and linked. For the follow-up of the cohort and aiming to minimise losses, the tracking of participants will be based on the periodic visits to all households of the study area held in the scope of the Dande-HDSS.

Quality control

The training of the field workers was conducted until the required competency was achieved for their specific tasks, and tested on the pilot study. A senior staff member of Dande-HDSS, responsible for the participant's enrolment and process trough the survey, will supervise all the fieldwork. Participants will be taken through the testing protocol in a sequential method, to prevent loss of data or stack in a particular station. Raw data from the field will be supervised every week to ensure the quality of data collected. Regular feedbacks between the field team and research assistants are schedule. All equipment will be maintained, serviced and calibrated according to manufacturer's specifications and schedules.

Data management

All questionnaires will be coded by experienced trained personnel and data will be double entered into a PostgreSQL® database. A series of logic checks will be performed and if any outliers are encounter, discrepancies will be followed up with research assistants and field supervisors. All digital data will be stored in password-protected files and hard copies of questionnaires warehoused in locked cabinets in the facilities of CISA, in Angola. Dande-HDSS supervision team will manage the access to the databases, ensuring the confidentiality of personal records of the participants. Files were designed to store all information related to participant identification separated from the remaining data collected so that all procedures, namely analysis, are maintained under anonymity.

Statistical analysis

Descriptive data will be reported as absolute frequencies and percentages, means and standard deviations as appropriate. Contingency tables with Pearson chi-squared tests and pairwise correlations will be used to identify variables associated with hypertension, hyperglycemia and hypercholesterolemia. Logistic regression models will be fitted, adjusting for potential confounding factors. Crude and adjusted odds ratios should be estimated for the identified variables with significant association. Adjusted prevalence ratios, computed using Poisson regression models with robust estimator [20], will also be used when appropriate. During follow-up, incidence rates will be calculated as the number of new cases divided by the total person-time at risk. Time at risk will be counted as the time between 2 evaluations for subjects who remained free of the index problem, and for the new cases, time at risk will be assumed as the midpoint of the time interval between evaluations. 95 % confidence intervals will be calculated and a significance level of $p < 0.05$ will be set for all determinations.

Discussion

The rise in CVDs and other NCDs is a major issue for global health, particularly in LMI countries, though not all countries have the resources to build national surveillance systems to provide solid data on the epidemiology of such diseases. In their absence and of the data from a nationwide STEPS, monitoring of NCDs can be

envisaged by structures such as the Dande-HDSS, which may contribute for the surveillance of the major chronic NCD risk factors in representative populations [21].

Due to unequal access to health care, periodic population-based studies based in HDSS can help to overcome the lack of health information, being useful in detecting variables such as risk factors, awareness rates and prevalence of symptoms, otherwise difficult to register in a facility-based system [22].

Being in an early stage of an epidemiological transition, Angola presents at the same time, an increase in premature deaths cause by NCDs and high rates of maternal and chid mortality caused by infections diseases [23]. The country stills records one of the highest rates of maternal mortality in the world (460 deaths per 100,000 live births) [24]. In this sense, the inclusion of a female reproductive history in this study and the possibility of cross information with morbidity and mortality data are an important component for the study of maternal health.

As in any longitudinal study, there will be a risk of dropout. Such problem is more common in cohort studies in Sub Saharan countries due to significant migration patterns and absence of usual means of follow-up used in high income-countries, such as central electronic medical records or unique identifiers to link different datasets [22, 25]. However, as described earlier, we predict to have periodic visits to all participants to keep them motivated between surveys, with a strong effort in all contacts to explain the purpose of the study and make people feel they are making a contribution. The engagement of local authorities is a key factor is this process, helping to build a relationship of trust with the participants. Also, additional resources and strategies can be applied to further follow-ups, such as the use of cell phones to contact and schedule follow-up visits and use weekend days to collect data.

Considering the settings where the protocol was applied, often in rural and inhospitable access hamlets, with straw dwellings and precarious structures, it will be necessary to create conditions for the application of the survey, in case of lack of an appropriate local structure (as a school, a church or a health centre). For this matter, the team projected and prepared a kind of a tent, using awnings and screens to ensure the comfort and privacy of the participants in the study and use it as study platform.

These harder conditions of the terrain and in the absence of local facilities to conduct laboratory tests or a reliable chain of refrigeration to maintain the right storage conditions for venous blood and urine, we choose to conduct dry chemistry using point of care devices that insure reliable results. In future follow-up actions, the possibility to adopt other laboratory methodologies is under consideration, such as the inclusion of the determination of the ratio of apolipoprotein B to apolipoprotein A-1.

Even using the STEPS methodology for better comparisons, due to the methodological differences namely in sampling frames and age groups used, direct comparisons between studies sometimes are not possible. The majority of the studies regarding CVDs and their risk factors only include individuals aged above 25 years. Having this in mind, we decided to maintain individuals aged 15–24 years in this study, because we want to create a cohort with a long-term follow-up, detecting how CVDs risk factors evolve in younger fractions of the population. If require to better compare results with other studies the necessary steps will be made to calculate the adjusted prevalence's.

In summary, CardioBengo can represent a solid baseline to launch a cohort able to provide critical data for the development of meaningful public health policy, integrated in the Angolan National Plan of Sanitary Development for the period 2012–2025, that predicts the need of further knowledge on CVDs in Angola to guide health promotions initiatives to the right group and problem [26].

Ethics approval and consent to participate

The Ethics Committee of the Angolan Ministry of Health has approved this protocol. In addition the study has received also the approvals of the ethics committee of the Institute of Public Health, University of Porto (ref CE14010), in the context of the doctoral programme in Public Health of JMP. A written informed consent was obtained from each participant (in the case of under 18 years old, their parent or legal guardian). A copy of the signed consent form as well as instructions regarding the fasting period and contact information was delivered to each participant.

Consent for publication

Not applicable.

Availability of data and material

All datasets are available from the CISA Data Base for researchers eligible for access upon request to info@cisacaxito.org.

Abbreviations

CISA: Health Research Centre of Angola; CVDs: cardiovascular diseases; Dande-HDSS: Dande Health and Demographic Surveillance System; LMI: low- and middle-income; NCDs: non-communicable diseases; STEPS: STEPwise approach to Surveillance; WHO: World Health Organization.

Competing interests

The authors declare that there are no competing interests financial or nonfinancial with regards to this study. The interpretation of data and presentation of information is not influenced by any personal or financial relationship with any individual or organization. JMP is a staff member of the Calouste Gulbenkian Foundation, a Portuguese philanthropic organization.

The author alone is responsible for the views expressed in this publication and they do not necessarily represent the decisions, policy or views of the Calouste Gulbenkian Foundation.

Authors' contributions

JMP participated in the design and analysis of the project, led the pilot study and drafted the paper. ER participated in the sampling of the population, training of the field staff and revised subsequent drafts of the paper. MB and HB participated in the study design and analysis, coordinated its implementation and revised subsequent drafts of the manuscript. All authors read and approved the final manuscript.

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3.4. Data collection

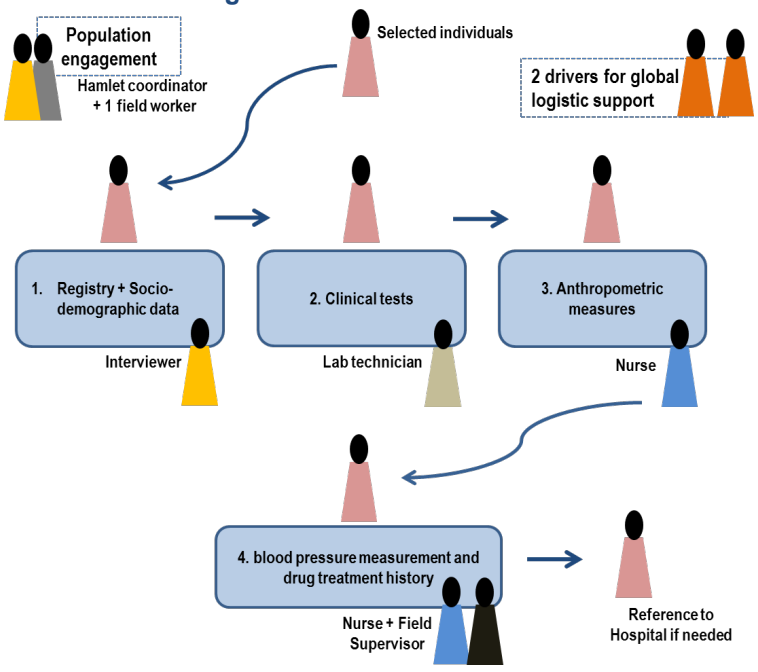
In this study, we followed the STEPS guidelines to facilitate further comparisons at the regional and global levels of the results (e.g., use of patronised questions). Another reason for this choice is the adequacy of methods recommended for a low-resources setting like the Dande-HDSS (e.g., use of point of care devices).

With experience from previous surveys, we implemented data collection procedures adequate to the population and conditions of the terrain. The selected individuals from the Dande-HDSS were contacted one or two days before the data collection, in a door-to-door method, to inform them of the purpose of the study and to schedule their observations for the next day if they agreed to participate.

This team also made the necessary arrangements for the fieldwork: engaging with the local authorities, involving them in the process of selecting an adequate location to install the study facilities. The field logistics were optimised to a model of four testing protocol stations (Figure 10):

1. Registry and socio-demographic data;
2. Point of care clinical tests;
3. Anthropometric measures;
4. Blood pressure measurement and drug treatment history.

Figure 10. Field work scheme



Considering the settings, often rural and inhospitable access hamlets, with straw dwellings and precarious structures, it was necessary to create the right conditions in the case an appropriate local structure (e.g., a school, a church or a health centre) was not available. For this matter, the team projected and prepared a tent, using awnings and screens to ensure the comfort and privacy of the participants during the clinical and anthropometric assessments.

The questionnaire was built in Portuguese (Annexe 1), but the conductors of the collection interviews could adapt and translate it to the other major national languages: Umbundo and Quimbundo. All procedures were conducted by trained interviewers from the Dande-HDSS and certified nurses or laboratory technicians.

This thesis's chosen variables and its methods of collection are summarised in Table 2.

Table 2. Variables and methods of data collection pertinent

Category	Variable	Collection tool	Reference
Socio-demographic	Sex	Interview	WHO STEPS[92]
	Age	Interview	WHO STEPS[92]
	Place of residence	Dande - HDSS	WHO STEPS[92]
	Education	Interview	WHO STEPS[92]
	Marital Status	Interview	WHO STEPS[92]
	Monthly Family Income	Interview	WHO STEPS[92]
Anthropometric	Body mass Index	Digital scale SECA 803 Stadiometer SECA 213	WHO[67]
	Abdominal obesity	Circumference tape SECA 203	WHO[67]
Behavioural	Tobacco smoking	Interview	WHO STEPS[92]
	Nicotine dependence	Interview	Fagerström Test[107]
	Alcohol consumption	Interview	WHO STEPS[92]
Clinical	Blood Pressure	Automatic sphygmomanometer OMRON M6 Comfort	ASH/ISH[34]
	Blood glucose	Blood glucose meter ACCU-CHEK Aviva	WHO[46]
	Blood total cholesterol	ACCUTREND Plus with ACCUTREND CHOLESTEROL reactive strips	WHO[4]
Treatment history	Awareness	Interview	WHO STEPS[92]
	Treatment	Interview	WHO STEPS[92]
	Control	Clinical result	WHO STEPS[92]

3.5. Ethical considerations

All procedures were developed to guarantee data confidentiality and protection, in accordance with the 1964 Helsinki declaration and its later amendments. This study received the approval of the Ethics Committee of the Angolan Ministry of Health before the implementation process.

All participants received an explanation of the purposes and design of the study (Annexe 2) and gave written informed consent (for participants under 18 years old, their parent or legal guardian gave constant), as presented in Annexe 3. A copy of the signed consent form, as well as instructions regarding the fasting period and contact information, was delivered to each participant and was also available in Umbundo and Quimbundo.

After the procedures, participants received cards summarising their clinical and anthropometric results (Annexe 4) and a small lunch to compensate for the fasting period. Individuals with abnormal clinical results were referred to the General Hospital of Bengo for a medical visit (Annexe 5).

3.6. Methodological Issues

The methodological issues present during this study are related to two major characteristics of an SSA country setting: the harder conditions of the terrain and the follow-up of individuals.

In the field, and in the absence of local facilities to conduct laboratory tests or a reliable chain of refrigeration to maintain the right storage conditions for venous blood, we chose to conduct dry chemistry using point of care devices that ensured reliable results. However, due to the high temperatures and humidity levels during field surveys, data collection was not possible in some cases, causing a greater amount of missing data than expected.

Although the Dande-HDSS has existed since 2010, its primarily objective is to measure births, deaths and household conditions, not guarantee the traceability of the entire population. This population has a high mobility, both inside and outside of the Dande-HDSS area, without leaving contacts or references for further contacts. Also, the study area's location, 60 km from the centre of the capital of Angola, promoted a daily flow of workers and students that left their homes in the morning only to return at the end of the day, missing the scheduled observation days.

These problems are common in cohort studies in SSA due to the fast migration movements of populations that follow the job opportunities related to natural resource exploration, growing urban areas and the natural cycle of croups.[108] The absence of efficient alternative means of follow-up used in high-income countries, such as electronic or postal mail, family doctor appointments, central electronic medical records or unique identifiers to link different datasets, increases these loss. [109-110] In recent years, the use of cell phones has been implemented as a traceability tool; however, the use of the same number for long periods is not common in the general population due to the quick access to deportable numbers and cell phone companies' mass campaigns with promotions and discounts.

Also, some variables were self-reported (education, alcohol and tobacco consumption, previous measurements and treatment), which may have resulted in self-report bias. Participants were asked not to eat anything eight hours before participating in the study; however, it was difficult to measure adherence to this appeal, which adds uncertainty to the measures of blood glucose and cholesterol.

In CardioBengo, we chose not to examine age groups over 65 years old (known for higher rates of the conditions studied) due to their low representation in the general population (only 3.6% in the Dande-HDSS), but instead to include younger participants (15 to 24 years), allowing us a better representation of the demographic structure and creating a stronger baseline for future surveys.

Finally, our study findings should be interpreted cautiously because, even with the similarities between the Dande-HDSS and the demographic structure of the country, the distribution of nonrespondents in our study was uneven, with a higher proportion of loss for younger people and men; this may have caused instability in the estimates in some strata.

It is therefore not possible to extrapolate our findings to a larger population at the country level, and this was not an objective of this study. However, it was possible to create a new baseline that may constitute the larger comprehensive community-based study in Angola for CVDs and associated risk factors

4. Results

4.1. Paper II - Incidence of Hypertension

Pedro JM, Mayer C, Nery SV, Brito M, Barros H.

Incidence of Hypertension in an Adult Population of Angola: a 2-years prospective study

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Abstract

Background: Hypertension is worldwide the most common risk factor for cardiovascular diseases. However, data on incidence is lacking for sub-Saharan Africa. This study in Bengo Province, Angola, reports on the incidence of hypertension and socio-demographic, behavioral and anthropometric characteristics.

Methods: A community sample of 303 individuals at risk for hypertension was evaluated after 2-years of follow-up, using World Health Organization STEPwise approach to Surveillance procedures. Cumulative incidence and relative risk were calculated, and Cochran-Matel-Haenszel method was used to compute sex-age-adjusted relative risk.

Results: The 2-years cumulative incidence of hypertension was 12.2%, similar in women (12.2%) and men (12.3%), but significantly higher in those >40 years (21.3% versus 8.1%) and living in rural areas (25.0% versus 10.3% in urban areas). Regular alcohol drinkers and overweight or obese individuals presented a significantly higher risk of developing hypertension (2.5 and 2.3, respectively). Among incident cases there was a low frequency of awareness (37.8%) and treatment (21.4%), without any controlled case.

Conclusions: This first time estimate of the incidence of hypertension in Angola, showed risk is high, and that much remains to be done regarding prevention and access to treatment.

Keywords: Hypertension; Incidence; Awareness; Cardiovascular diseases; Sub-Saharan Africa.

Introduction

Non-communicable diseases (NCD) are the principal cause of death worldwide, except in Africa where infection remains the first cause of mortality. In Africa, the frequency of NCD is rising rapidly, and by 2030, it will surpass the death burden of communicable diseases [1].

Cardiovascular diseases (CVD) were the leading NCD as cause of death in 2012, responsible for 17.5 million deaths worldwide, mostly occurring in low- and middle-income countries [1]. A large proportion of CVD depends on the exposure to modifiable risk factors (tobacco, alcohol, diet and physical activity) that influence metabolic pathways and ultimately results in obesity and/or hypertension [1, 2]. Hypertension is estimated to have contributed to 9.4 million deaths in 2010, and to 7% of the worldwide disease burden, measured as disability-adjusted life years [3].

Hypertension is the most common risk factor for CVD in sub-Saharan Africa (SSA), with the prevalence of hypertension documented in multiple systematic reviews [4-7]. But, to our knowledge, there isn't any determination of incidence in the general adult population in this part of the world. Incidence is the true measure of risk and allows a better understanding of the operating determinants of complex diseases. However, social instability and a fast-growing economy, which increases mobility and clustering of populations, common in many SSA countries, challenge the design and implementation of follow-up studies [8]. During four decades, from 1966 to 2009, only 41 longitudinal studies on CVD and related risk factors were conducted in Africa (only 1 on hypertension in 1973, in Ghana), covering just 11 countries and clustering in South Africa and Nigeria [9]. Only 10 were community-based cohorts, presenting methodological shortcomings of small sample size and high dropout rates [9].

Angola, located in the Atlantic coast of Middle Africa, faced a long period of civil war that impeded the development of health care and educational infrastructures, and forced the relocation of people to safer places, namely major cities, such as the capital, Luanda. The economic growth and urbanization, started in 2002 with the end of the civil war, might ultimately result in a further increased prevalence of risk factors for NCD and CVD-related mortality, which represented 9% of adult deaths in 2013 [10].

Three studies provided information on the prevalence of hypertension in Angola: a survey of adult students of Health Sciences in Lubango, that reported a prevalence of 23.5% [11]; a study of employees from the public university Agostinho Neto, Luanda, described a

prevalence of 45.2% [12]; and a survey of the adult community of Bengo where a 23% prevalence of hypertension was found in 2011 [13].

The current prospective longitudinal study reports on the incidence of hypertension at the 2 years follow-up of a sample of adult's residents in Bengo Province, who were identified at risk for hypertension during a community survey.

Methods

Study site

This study was conducted in the catchment area of the Centro de Investigação em Saúde de Angola (CISA), that includes the Dande Health and Demographic Surveillance System (Dande-HDSS) that monitors the structure, dynamics, and geographical distribution of a population of 60,075 (53.5% 18 years and older), spread across 4,700 km^2 covering 3 communes (Caxito, Mabubas and Úcua) of the Dande Municipality, in Bengo Province, 60 km north of Luanda, the capital of Angola [14].

Study design

This is a prospective cohort study. A representative sex- and age-stratified random sample was drawn from the Dande-HDSS database and 1464 individuals older than 18 years were recruited and evaluated from 11 October to 20 December 2011 [13]. Then, from 18 September to 20 December 2013, participants with normal blood pressure at the initial round were approached and offered a new evaluation. Eligible individuals were considered unreachable after 2 failed attempts of contact in their household at different hours in weekdays, and as a refusal if explicitly communicates their willingness in not participating.

Data collection

Data were collected by trained interviewers and certified nurses, able to communicate in Portuguese (official language) and in other spoken local languages. The protocol for data collection was the same used at baseline [13]. Socio-demographic characteristics and behavioural exposures (i.e., alcohol and tobacco consumption) were collected using structured questionnaires adapted from the World Health Organization STEPwise approach to Surveillance (STEPS) manual [15], translated to Portuguese, pre-tested, and piloted before data collection.

Physical evaluation was performed after an overnight fast, with participants in light clothing and no footwear [16]. Waist and hip circumferences were measured to the nearest 0.1 cm

using circumference tape SECA 203 (SECA United Kingdom, Birmingham, UK). Body weight was measured to the nearest 0.1 kg using a digital scale SECA 803 (SECA United Kingdom, Birmingham, UK). Height was measured to the nearest 0.1 cm in the standing position using a portable stadiometer SECA 213 (SECA United Kingdom, Birmingham, UK). Body Mass Index (BMI) was calculated as weight (kg) divided by squared height (m2). Subjects were categorized according to WHO recommendations: underweight and normal (<24.9 kg/m2), overweight and obese (≥25 kg/m2) [16]. The waist-to-hip ratio was calculated as the circumference of the waist (cm) to that of the hips (cm), and abdominal obesity defined as ≥0.9 for men and ≥0.85 for women [17].

Blood pressure was measured using the automatic sphygmomanometer OMRON M6 Comfort (OMRON Healthcare Europe B.V., Hoofddorp, The Netherlands) as recommended [18]. After a 15-minute rest, 3 readings were taken, 3 minutes apart. Measurements were made with the participant seated, on the right arm, and using the appropriate cuff size. For data analysis, the average of the last 2 readings was used [15]. Hypertension was defined as a systolic blood pressure of ≥140 mmHg and/or diastolic blood pressure of ≥90 mmHg and/or use of anti-hypertensive drug therapy during the previous 2 weeks [19].

Following STEPS guidelines [15], information on a diagnosis of hypertension during the follow-up period was obtained by questioning previous measurements of blood pressure. In case of a positive answer, participants were inquired about their awareness of the diagnosis done by a health care worker. Any individual was considered under treatment if he/she indicated the use of specific medication, and considered controlled if he/she had an actual normal blood pressure reading.

For analysis, age was divided into 2 groups: younger or equal to 40 years, and 41 years or older. Frequent alcohol drinkers were defined as consumers of any alcohol 3 or more days per week and current smokers as those who reported smoking at least 1 cigarette per day. Education was categorized according the number of completed schooling years as none, and 1 or more. The area of residence was classified as rural or urban as previously reported [14].

Ethics approval and consent to participate

All procedures performed in this study involving human participants were in accordance with the ethical standards of the Ethics Committee of the Angolan Ministry of Health, that approved the study protocol, and with the latest version of the Helsinki declaration. Written informed consent was obtained from all individual participants included in the study. All

participants with blood pressure readings in the range of values defined as hypertension were referred to the General Hospital of Bengo for a follow-up evaluation with a cardiologist.

Follow-up

At baseline 1,464 subjects were evaluated and hypertension was diagnosed in 322 individuals [13]. Among the remaining 1,142 participants, 108 women were pregnant at the time of baseline evaluation and were excluded because of the expected alterations in anthropometric measurements and pregnancy-related blood pressure variation [20]. From the 1,034 eligible individuals, 9 died during the 2 years period, 6 refused to participate, 211 were known to have migrated outside the study area and unreachable, and 488 were not traceable during the survey time (Figure 1). From the 320 evaluated individuals (30.9% of the eligible participants), 17 were pregnant women, and thus not considered for analysis. Therefore, 303 remained for the present analysis. The median (interquartile range) follow-up period was 2.0 years (1.9-2.2 years).

Compared with subjects lost to follow-up participants showed no significant differences at baseline in the prevalence of smoking and drinking, abdominal obesity and BMI categories, and mean systolic or diastolic blood pressure. However, participants were significantly older, more frequently women, less educated, and more likely to live in rural areas (Table 1).

Statistical analysis

Data was double entered into a PostgreSQL® database system and imported into SPSS® version 22 (IBM, New York, USA) for statistical analysis. Data is presented as absolute frequencies and percentages, and means and standard deviations (SD) when appropriate. Pearson's chi-squared test and the Mann–Whitney U test were used to compare the characteristics of individuals in the follow-up group and those who were lost to follow-up. Cumulative incidence and relative risk (RR) were calculated for the 2-years period. The Cochran-Matel-Haenszel method was used to compute sex-age-adjusted RR [21]. A 95% confidence interval (95% CI) was computed for each point estimate and a significance level of $p<0.05$ was considered.

Results

Participant's mean age was 33.9 years (SD 12.8), 62.4% of them being women, a fifth had no formal education and 13.2% lived in rural areas. The prevalence of daily smoking was 8.9% and that of frequent drinking 43.9%, almost a quarter of the sample presented overweight or obesity, and two fifths showed abdominal obesity (Table 1).

The crude cumulative incidence of hypertension is 12.2%, similar according to sex and education, but higher above 40 years (21.3% versus 8.1%) and in rural areas (25.0% versus 10.3%) (Table 1).

A significantly higher risk of developing hypertension was found in overweighed and obese participants (adjusted RR = 2.3; 95% CI: 1.3 to 4.8) and among regular drinkers (adjusted RR = 2.5; 95% CI: 1.3 to 4.1). No significant association was observed with smoking (adjusted RR = 0.9; 95%: 0.3 to 2.2) or abdominal obesity (adjusted RR = 1.7; 95%: 0.8 to 3.4) (Table 1).

Among the 37 newly identified cases, 14 (37.8%; 95% CI: 24.1 to 53.9) were aware of their status, but only three ever received medication (21.4%; 95% CI: 7.6 to 47.6), of which 2 were on prescribed medication, none had their hypertension controlled. Awareness level was higher in the older group, namely in women (57.1%; 95% CI: 32.6 to 78.6) but treatment was more frequent in younger men (66.7%; 95% CI: 20.8 to 93.8).

Discussion

To the best of our knowledge, this is the first study that provides a measurement of the incidence of hypertension in SSA communities. In SSA, trends of hypertension, a surrogate to approach incidence, are based on cross-sectional studies like the one conducted in Cameroon that found a significantly increased by 2 to 5-fold in rural and urban men and women over a ten-year period [22]. Another way is the use of pooled prevalence from different countries that shows an increased from 19.7% in 1990, to 27.4% in 2000 and 30.8% in 2010 for all Africa [6]. A review of studies focused on West Africa showed that the crude prevalence of hypertension increased progressively from 12.9% in the 1980s to 34.4% in 2010-2014 [23].

Looking to other countries and regions, the annual age-standardized incidence in a German adult population aged 45 to 83 years was 8% to 9% in 2002-2006 and 5% to 6% for the next 5 years of follow-up [24] and for a Portuguese urban population the overall incidence rate was 47.3 per 1000 person-years, higher in men [25]. Within the China Health and Nutrition Survey an incidence rate of hypertension of 2.9 per 100 person-years was found in 1991-1997 and significantly increased to 5.3 per 100 person-years in 2004-2009 [26]. The incidence now calculated for our study population is higher then described for non-SSA countries, concurring with the pooled increase of hypertension predicted for the region by

WHO, in contrast to many countries worldwide where the rates of CVD risk factors are slowly decreasing [27].

In our sample, the risk of developing hypertension increases with age, drinking alcohol and obesity. The increased risk of hypertension in the presence of these factors is well recognized and the fact that we also observed it favours the validity of our estimates despite the large attrition observed in our sample [1-2, 4-7]. Men are generally at greater risk for CVD than are age-matched, premenopausal women, with higher blood pressure values than in women at similar ages. After menopause, however, blood pressure increases in women to levels even higher than in men [28]. Smoking has not been conclusively proven to cause hypertension, but smokers were shown to be at higher risk for elevated blood pressure, particularly after smoking, and present a much higher risk of CVD events than non-smokers [29]. In our sample, and although there was a low frequency of smokers, we also did not find a significant association with risk of hypertension, with the crude risk close to one in both genders. However, as smoking is increasing in Africa [1] and due to other well-known health consequences of smoking this finding cannot result in overlooking the importance of tobacco. As found in 2011 in the region, awareness of the hypertensive status was more frequent in the older group but overall it seemed to increase (37.8% vs. 21.6%) [13], being similar to the pooled rate in Africa of 33.7% in 2010 [6], but higher than the 27% found in SSA [7]. Treatment was reported by 8.1% of the affected individuals (13.9% in 2011) and lower than the polled rate of 18% of treated individuals in these studies. Furthermore, none presented controlled blood pressure, opposed to the 7% with controlled blood pressure in SSA studies [7]. However, the number of treated patients was too small to allow conclusions.

These findings stress the need to implement access to affordable anti-hypertensive drugs and the inclusion of NCDs prevention and clinical management in primary care, to reduce the future burden of morbidity and early mortality associated with hypertension [30]. According to the Dande-HDSS Verbal Autopsy System, among the 407 reported deaths in adults (>15 years old) that occurred from 2009 to 2012, 59 (14.5%) were due to circulatory system diseases, the main cause of death attributable to a specific disease in this population for this period [31].

The study limitations need to be recognized. It is based on a relatively small sample, reflecting a high attrition rate, with almost two thirds of eligible individuals not being found. This problem, common in cohort studies in SSA, reflects important migration movements and the absence of efficient alternative means of follow-up as used in high income-countries, such as electronic or postal mail, family doctor appointments, central electronic medical

records or unique identifiers to link different datasets [32, 33]. The surveillance system in place, the Dande-HDSS, which primarily assesses births, deaths, and household conditions, was not able to guarantee the traceability of a large proportion of this population, with high mobility. Expecting such constraints a 2-year follow-up period was defined, but even within a short time frame it was only possible to reach 30% of the eligible individuals. This attrition results in a possible bias due to the fact that individuals who were evaluated were significantly older and with a larger presence of women. These limit external validity but looking at the founded impact of determinants expected to increase the incidence of hypertension, and that no differences were found regarding baseline blood pressure between the group lost to follow-up and followed, a major indicator of risk of developing hypertension [34], we can be confident about the importance of the measured incidence as an indicator of the expected burden of cardiovascular related outcomes in this population.

Conclusions

This study provides the first estimate of the incidence of hypertension in an Angolan adult population. Despite the limitations described, our results are align with others from the SSA showing that hypertension frequency is increasing, with low levels of awareness, access to treatment and difficulties in controlling blood pressure.

Health care systems in SSA, mainly focused in communicable diseases, need to address the announced global epidemic of CVD and their associated risk factors, and to reliably recognize the perception and impact of these diseases in the populations through large community based studies [1, 30].

For this specific population, and considering the relative risk of hypertension in the presence of overweight or obesity and alcohol use, health promotion initiatives need to focus these risk factors, and as early as possible, time to minimize new cases of hypertension and related early mortality. Since young people are a major target of campaigns to prevent infectious diseases, such opportunities could also be used to alert to shared and additional behavioural factors associated with NCD [30].

Data Availability

The data used to support the findings of this study were provided by Dande-HDSS Data Base under license, and so cannot be made freely available. Access to these data will be considered upon request, with permission of the Dande-HDSS administrator. Inquiries can me made to info@cisacaxito.org.

Conflicts of Interest

The authors declare that there are no competing interests financial or nonfinancial with regards to this study. The interpretation of data and presentation of information is not influenced by any personal or financial relationship with any individual or organization. JMP is a staff member of the Calouste Gulbenkian Foundation, a Portuguese philanthropic organization. The author alone is responsible for the views expressed in this publication and they do not necessarily represent the decisions, policy, or views of the Calouste Gulbenkian Foundation.

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Figures and tables

Figure 1. Flowchart illustrating the sample selection for the present analysis

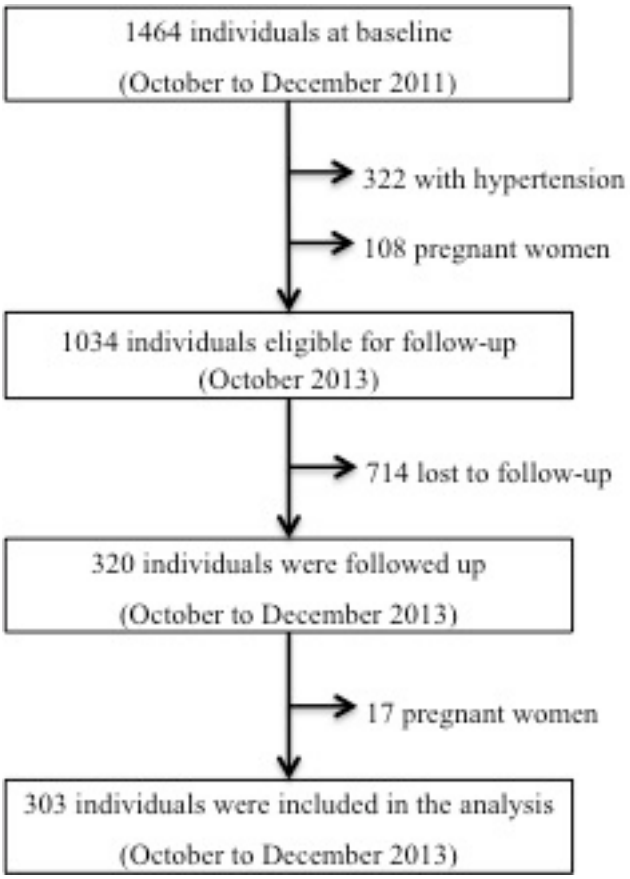

Table 1. Comparison of baseline characteristics of participants with and without follow-up interview and cumulative Incidence and relative risk of hypertension

	Lost to follow-up (%) (n=707)	Followed up (%) (n=303)	P value	*Number of new cases*	*Cumulative Incidence (%) (95% CI)*	*Crude RR (95% CI)*	*Adjusted RR[a] (95% CI)*
Total (n=303)	-	-	-	*37*	*12.2 (9.4 to 15.6)*	-	-
Sex (n=1,010)							
Men	330 (46.7)	114 (37.6)	0.008	14	12.3 (8.1 to 18.2)	1.0 (0.6 to 1.9)[b]	1.1 (0.6 to 2.0)[b,c]
Women	377 (53.3)	189 (62.4)		23	12.2 (8.8 to 16.6)	1	1
Age (n=1010)							
>40 years	133 (18.8)	94 (31.0)	0.000	20	21.3 (14.2 to 30.6)	2.6 (1.4 to 4.8)	2.7 (1.4 to 4.9)[d]
≤40 years	574 (81.2)	209 (69.0)		17	8.1 (5.1 to 12.6)	1	1
Mean±SD (years)	30.7±10.9	33.9±12.8		-	-	-	-
Education (n=1,007)							
None	102 (14.5)	59 (19.5)	0.048	7	11.9 (5.9 to 22.5)	1.0 (0.5 to 2.1)[b]	0.7 (0.3 to 1.5)[b]
≥1 year school	602 (85.5)	244 (80.5)		30	12.3 (8.8 to 17.0)	1	1
Area of residence (n=1,010)							
Rural	59 (8.3)	40 (13.2)	0.026	10	25.0 (14.6 to 41.1)	2.4 (1.3 to 4.6)	2.0 (1.0 to 3.8)
Urban	648 (91.7)	263 (86.8)		27	10.3 (7.1 to 14.5)	1	1
Current smoker (n=1,010)							
Yes	64 (9.1)	27 (8.9)	0.943	4	14.8 (5.9 to 32.5)	1.2 (0.5 to 3.2)[b]	0.9 (0.3 to 2.2)[b]
No	643 (90.9)	276 (91.1)		33	12.0 (8.6 to 16.3)	1	1
Current drinker (n=1,008)							
Yes	328 (46.4)	133 (43.9)	0.371	24	18.0 (12.4 to 25.4)	2.4 (1.3 to 4.5)	2.5 (1.3 to 4.8)
No	377 (53.3)	170 (56.1)		13	7.6 (4.5 to 12.6)	1	1
Abdominal obesity[e] (n=1,010)							
Yes	283 (40.0)	117 (38.6)	0.576	20	17.1 (11.3 to 24.9)	1.9 (1.0 to 3.4)	1.7 (0.8 to 3.4)[b]
No	424 (60.0)	186 (61.4)		17	9.1 (5.8 to 14.1)	1	1
Mean±SD (years)	0.85±0.06	0.85±0.06		-	-	-	-
BMI[f] (kg/m^2) (n=1,010)							
Overweight/obese (≥25)	189 (26.7)	72 (23.8)	0.312	16	22.2 (14.2 to 33.1)	2.4 (1.4 to 4.4)	2.3 (1.3 to 4.1)
Underweight/normal (<25)	518 (73.3)	231 (76.2)		21	9.1 (6.0 to 13.5)	1	1
Mean±SD (kg/m2)	22.8±4.0	22.6±4.1					
SBP[g] (mmHg) (n=1,010)							
Mean±SD	121.9±10.5	121.1±10.4	0.210	-	-	-	-
DBP[h] (mmHg) (n=1,010)							
Mean±SD	69.4±9.2	68.9±9.7	0.368	-	-	-	-

95% CI: 95% confidence interval; RR: relative risk.

[a] Adjusted for sex and age applying the Cochran-Matel-Haenszel method

[b] No statistical significance (p>0.05)

[c] Adjusted for age applying the Cochran-Matel-Haenszel method

[d] Adjusted for sex applying the Cochran-Matel-Haenszel method

[e] WHR ≥0.9 for men and ≥0.85 for women.

[f] Body Mass Index

[g] Systolic blood pressure

[h] Diastolic blood pressure

4.2. Paper III - Prevalence of Risk Factors

Pedro JM, Brito M, Barros H.

Prevalence, awareness, treatment, and control of hypertension, diabetes, and hypercholesterolaemia among adults in Dande Municipality, Angola

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Cardiovascular Topics

Prevalence, awareness, treatment and control of hypertension, diabetes and hypercholesterolaemia among adults in Dande municipality, Angola

João M Pedro, Miguel Brito, Henrique Barros

Abstract

Objectives: To estimate the prevalence, awareness, treatment and control of hypertension, diabetes and hypercholesterolaemia in an Angolan population aged 15 to 64 years and to determine relationships with sociodemographic, behavioural and anthropometric characteristics.

Methods: A total of 2 354 individuals were assessed for behavioural, sociodemographic and physical characteristics in a cross-sectional, community-based survey. Post-stratification survey weights were applied to obtain prevalence levels. Adjusted odds ratios for each variable related to the conditions were calculated using logistic regression models.

Results: Overall, the prevalence of hypertension was 18.0%, diabetes 9.2% and hypercholesterolaemia 4.0%. Among hypertensive individuals, the awareness rate was 48.5%; 15.8% were on treatment and 9.1% had their blood pressure controlled. Only 10.8% were aware they had diabetes, 4.5% were on treatment and 2.7% were controlled. The awareness level for hypercholesterolaemia was 4.2%, with 1.4% individuals on treatment and 1.4% controlled.

Conclusions: The prevalence levels of hypertension and diabetes, which were higher than previous findings for the region, together with the observed low rates of awareness, treatment and control of all conditions studied, constitute an additional challenge to the regional health structures, which must rapidly adapt to the epidemiological shift occurring in this population.

Keywords: epidemiology, hypertension, diabetes, hypercholesterolaemia, sub-Saharan Africa

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Cardiovascular disease (CVD), a major cause of non-communicable diseases (NCDs), was responsible for 17.5 million deaths worldwide in 2012, most occurring in low- and middle-income countries (LMIC). In Africa, the frequency of NCDs is rising rapidly, reflecting the combined effect of population growth and ageing, as well as nutritional and epidemiological transitions.[1]

A large proportion of CVD is the result of exposure to modifiable risk factors (tobacco and alcohol consumption, unhealthy diet and physical inactivity), which influence metabolic pathways and ultimately result in obesity, hypertension, diabetes or hypercholesterolaemia.[1,2] Together, these known adverse conditions explain approximately half of CVD cases, as demonstrated in the MONICA project and the INTERHEART study.[3,4]

Among the African population participating in the INTERHEART study, five risk factors (smoking, diabetes, hypertension, abdominal obesity and an elevated apolipoprotein B to apolipoprotein A-1 ratio) accounted for 89.2% of the population-attributable risk for the first myocardial infarction.[5] The same study suggested that uncontrolled major risk factors have a larger impact on the burden of CVD in Africa than elsewhere in the world.[5]

If the current trends persist, the risk of dying from NCDs will increase in the African region. However, this rising risk could be reversed by reaching the proposed targets for six behavioural and physiological risk factors (tobacco and alcohol use, salt intake, obesity and increased blood pressure and glucose levels) out of the nine global targets proposed by the World Health Organisation (WHO) in the Global Action Plan for the Prevention and Control of NCD 2013–2020.[6,7]

To follow the achievement of those goals, there is a need for sound and updated epidemiological data from all regions of the world. The majority of published studies for the African region are conducted at hospital services, which does not allow one to detect risk factors, awareness rates and prevalence of such conditions in the general population.[8-10] To provide core data on established risk factors for the major NCDs within the context of low-resource settings, WHO designed the STEPwise approach to Surveillance (STEPS).[11] STEPS uses a modular structure with

standardised questions and protocols, allowing adjustment of its application and appropriate comparisons across surveys.[11]

In Angola, infectious disease and maternal and child health-related problems remain the major causes of morbidity and mortality.[12] However, an increased burden of NCDs has been observed, particularly CVD, which was responsible for 9% of adult deaths in 2013.[13] Beyond general vital statistics, specific epidemiological information on CVD risk factors in Angola is based on only four local studies published after 2000: a survey of 667 adult students of Health Sciences in Lubango (prevalence of hypertension of 23.5%),[14] a study conducted among 615 active employees of the University Agostinho Neto, Luanda (prevalence of hypertension 45.2% and hypercholesterolaemia 11.1%),[15] 1 464 participants surveyed in the Dande Health and Demographic Surveillance System (Dande-HDSS) catchment area (23% prevalence of hypertension),[16] and a study of 421 subjects from a rural community of Angola (2.8% prevalence of diabetes).[17]

Building on the work carried out by Pires and colleagues,[16] and based on the STEPS methodology,[11] this study aimed to expand the sample population to the 15- to 24-year-old group, and to estimate the prevalence, awareness, treatment and control of hypertension, diabetes and hypercholesterolaemia, and its association with sociodemographic (gender, age, education and area of residence), behavioural (alcohol and tobacco consumption) and anthropometric [body mass index (BMI) and abdominal obesity] variables among 15- to 64-year-olds in the Dande-HDSS population.

Methods

A cross-sectional, community-based survey was conducted from September 2013 to March 2014 in the catchment area of the Dande-HDSS, located in Dande municipality of Bengo Province, Angola.[18] A representative gender- and age-stratified random sample list of 3 515 individuals, aged between 15 and 64 years, was drawn, as described previously.[19] Of these, we were able to examine 2 484 (70.7%) individuals, 750 (21.3%) were unreachable and 281 (8.0%) refused to participate, thus approaching the predicted non-participation rate of 30%.[19]

For analysis, we excluded participants with missing anthropometric values (n = 14) and pregnant women (n =116) due to the fact that anthropometric parameters vary during pregnancy. Therefore 2 354 individuals (67.0%) were included in the final analysis.

Information on age, completed years of school education, alcohol and tobacco consumption, and the previous measurement of any of the conditions under investigation, were collected through a structured interview conducted by trained interviewers, following a previously published protocol for data collection based on the WHO STEPS manual version 3.0.[11,19]

For this analysis, age was categorised into five 10-year age groups: 15 to 24, 25 to 34, 35 to 44, 45 to 54 and 55 to 64 years old. Education was categorised according to the number of completed years of schooling: none, one to four years, five to nine years, and 10 years or more. Area of residence was classified as rural or urban, as previously described.[18] Alcohol consumption was defined as none if participants reported no alcohol consumption; occasional if participants reported drinking alcohol two or less days per week; and frequent if drinking any alcohol three or more days per week. Current tobacco smokers were defined as participants who reported smoking at least one cigarette per day.

Previous measurements of blood pressure, and glucose or cholesterol levels in the last year were requested from all participants. In the case of a positive answer, participants were questioned about their awareness of a previous diagnosis of hypertension, diabetes or hypercholesterolaemia made by a healthcare worker. Any individual was considered under treatment if he/she indicated the use of a specific medication; a participant was considered controlled if they had a current normal value.

Certified health professionals conducted all anthropometric and clinical measurements, as described previously.[19] Anthropometric measurements were performed with individuals wearing light clothing and no footwear, and an overnight fast was requested of all participants.

Body mass and height were measured using a digital scale SECA 803 (SECA United Kingdom, Birmingham, UK) and a portable stadiometer SECA 213 (SECA United Kingdom, Birmingham, UK). BMI was defined as the body mass (kg) divided by the square of the body height (m^2), and further categorised according to WHO as underweight (< 18.5 kg/m^2), normal (18.5 to 24.99 kg/m^2), overweight (25.0 to 29.99 kg/m^2) and obese (≥ 30 kg/m^2).[20]

Waist and hip circumferences were measured using circumference tape SECA 203 (SECA United Kingdom, Birmingham, UK). The waist-to-hip ratio was calculated as the circumference of the waist (cm) to that of the hips (cm), and abdominal obesity was defined as waist-to-hip ratio ≥ 0.9 for men and ≥ 0.85 for women.[21]

Blood pressure was measured on the right arm with the automatic sphygmomanometer OMRON M6 Comfort (OMRON Healthcare Europe BV, Hoofddorp, The Netherlands), with the individual seated, and using an appropriate cuff size. Three readings were done at three-minute intervals. The mean value of the last two measurements was used to determine the blood pressure. Hypertension was defined as systolic blood pressure of ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg and/or use of antihypertensive drugs during the previous two weeks.[22]

Blood sugar was measured using a blood glucose meter ACCU-CHEK Aviva (Roche Diagnostic, Indianapolis, IN, USA) with ACCU-CHEK Aviva glucose reactive strips (Roche Diagnostic, Indianapolis, IN, USA). The definition of diabetes followed WHO diagnostic criteria of 126 mg/dl (6.9 mmol/l) glucose in a fasting blood sample,[23] and/or use of antidiabetic drugs during the previous two weeks.

Total cholesterol in the blood was measured using a point-of-care device ACCUTREND Plus (Roche Diagnostic, Indianapolis, IN, USA) with ACCUTREND cholesterol reactive strips (Roche Diagnostic, Indianapolis, IN, USA). Hypercholesterolaemia was defined according to WHO diagnostic criteria for STEPS, with cholesterol ≥ 240 mg/dl (6.2 mmol/l) in a fasting blood sample,[2,11] and/or use of anticholesterol drugs during the previous two weeks.

All procedures performed in this study were in accordance with the standards of the ethics committee of the Angolan Ministry of Health and with the 1964 Helsinki declaration and its later amendments. Written informed consent was obtained from all individual participants included in the study (in the case of those under 18 years old, from their parent or legal guardian).

A copy of the signed consent form, as well as instructions regarding the fasting period and contact information, were delivered to each participant.

Statistical analysis

Data were double entered into a PostgreSQL® database and SPSS® version 22 (IBM Corp, Armonk, NY, USA) was used for statistical analysis. Post-stratification survey weights were calculated using the known gender and categorical age distribution of the Dande-HDSS population,[17] and these were used in all further calculations. Descriptive data are reported as absolute frequencies and percentages or means and standard deviations (SD), as appropriate.

To facilitate comparisons with other studies, the prevalence of the three conditions under study was determined for three age groups: 15 to 64, 18 to 64 and 25 to 64 years. Logistic regression models were fitted to the categorical variable of age because of its known effect on hypertension, diabetes and hypercholesterolaemia. Gender-specific adjusted odds ratios (OR) were estimated for each variable (age, residence, education, BMI, abdominal obesity, tobacco and alcohol consumption) related to the conditions studied. A 95% confidence interval (95% CI) and a significance level of $p < 0.05$ were set for all applicable determinations.

Table 1. Socio-demographic, anthropometric and behavioral characteristics of the population (Caxito, 2016)

	All participants (n = 2 354)	*Female (n = 1 222)*	*Male (n = 1 132)*
Age (years) (n = 2 354)	*% (95% CI)**	*% (95% CI)**	*% (95% CI)**
15–24	36.2 (34.3–38.1)	30.1 (27.6–32.7)	42.7 (39.9–45.6)
25–34	25.9 (24.2–27.7)	25.4 (23.0–27.9)	26.5 (24.0–29.1)
35–45	16.1 (14.7–17.6)	18.7 (16.6–20.9)	13.3 (11.5–15.4)
45–54	12.6 (11.3–14.0)	15.3 (13.4–17.4)	9.7 (8.1–11.6)
55–64	9.2 (8.1–10.4)	10.6 (9.0–12.4)	7.8 (6.3–9.5)
Residence (n = 2 354)			
Urban	81.0 (79.4–82.5)	81.2 (78.9–83.3)	80.8 (78.4–83.0)
Rural	19.0 (17.5–20.6)	18.8 (16.7–21.1)	19.2 (17.0–21.6)
Education (years completed) (n = 2 348)			
None	9.3 (8.2–10.5)	16.6 (14.6–18.8)	1.4 (0.9–2.3)
1–4	23.1 (21.5–24.9)	34.5 (31.9–37.2)	10.9 (9.2–12.8)
5–9	42.2 (40.2–44.2)	35.7 (33.1–38.5)	49.2 (46.3–52.1)
> 10	25.4 (23.7–27.2)	13.1 (11.4–15.2)	38.5 (35.7–41.4)
BMI class (kg/m²) (n = 2 354)			
Underweight (< 18.5)	11.3 (10.1–12.6)	10.2 (8.7–12.1)	12.5 (10.7–14.5)
Normal (18.5–24.9)	66.1 (64.1–67.9)	58.7 (55.9–61.4)	74.0 (71.4–76.5)
Overweight (25.0–29.9)	15.8 (14.4–17.3)	20.5 (18.4–22.9)	10.7 (9.0–12.6)
Obese (≥ 30)	6.8 (5.9–7.9)	10.6 (9.0–12.4)	2.8 (2.0–4.0)
Abdominal obesity (n = 2 354)			
No	75.1 (73.3–76.8)	63.5 (60.8–66.2)	87.6 (85.6–89.4)
Yes	24.9 (23.2–26.7)	36.5 (33.8–39.2)	12.4 (10.6–14.4)
Tobacco smoking (n = 2 342)			
Non-current	93.8 (92.7–94.7)	97.3 (96.2–98.1)	90.0 (88.1–91.6)
Current	6.2 (5.3–7.3)	2.7 (1.9–3.8)	10.0 (8.4–11.9)
Alcohol consumption (n = 2 335)			
No consumption	63.8 (61.8–65.7)	69.5 (66.9–72.0)	57.6 (54.7–60.4)
Occasional (< 3 days per week)	18.8 (17.2–20.4)	19.6 (17.5–21.9)	17.8 (15.7–20.2)
Frequent (≥ 3 days per week)	17.5 (16.0–19.1)	10.9 (9.2–12.7)	24.6 (22.2–27.2)

*Post-stratification weights used as described in the methods section.

Results

The mean age of this population was 32.5 years (SD 13.6) with 63.0% (n = 1 482) women and the majority (81.0%) living in urban settings. Nearly 10% had never received any formal education, with men having completed more school years. Overall, almost a quarter of participants had abdominal obesity (36.5% of women and 12.4% of men), 6.8% were obese (10.6% of women and 2.8% of men), 6.2% were smokers (2.7% of women and 10.0% of men) and approximately two-fifths consumed alcohol occasionally or frequently, with a higher proportion of frequent drinkers among men (24.6 vs 10.9%) (Table 1).

The prevalence of hypertension in the general population was 18.0%, reaching 20.0% in those over 18 years of age, and 26.6% in those aged 25 to 64 years (Table 2). This prevalence was always higher among women than men, but with no statistically significant relationship (data not shown).

The overall prevalence of diabetes among participants aged 15 to 64 years was 9.2%; the prevalence among those over 18 years old was 9.8%, and 11.9% in those aged over 25 years (Table 2). Men had a higher OR than women for diabetes of 1.4 (95% CI: 1.0–1.8, data not shown).

Similar to that of hypertension and diabetes, the prevalence of hypercholesterolaemia was higher in the older age groups, with an estimated 5.5% in participants aged 25 to 64 years, and a lower prevalence of 4.0% in the overall population (Table 2). Women had an OR of 2.3 (95% CI: 1.3–4.0, data not show) for hypercholesterolaemia.

Only five participants (0.2%; 95% CI: 0.1–0.4, data not shown) presented all three conditions, but 22.0% (95% CI: 18.4–26.2, data not shown) of hypertensive participants had an associated condition, as did 37.2% (95% CI: 31.1–43.7, data not shown) of participants with diabetes and 47.9% (95% CI: 36.7–59.3, data not shown) of those with hypercholesterolaemia. The most common associations were hypertension and diabetes, present in 71 individuals (3.0%; 95% CI: 2.4–3.7, data not shown).

The prevalence of hypertension was higher in rural areas (26.9 vs 15.9% in urban areas) for both genders. Individuals with lower levels of education had a higher prevalence of hypertension, with women with no formal education presenting an OR for hypertension of 4.3 (Table 3).

Table 2. Prevalence of hypertension, diabetes and hypercholesterolaemia by gender and age (Caxito, 2016)

	All Participants			*Female*			*Male*		
	15–64 years (n = 2 354)	*18–64 years (n = 2 100)*	*25–64 years (n = 1 503)*	*15–64 years (n = 1 222)*	*18–64 years (n = 1 116)*	*25–64 years (n = 854)*	*15–64 years (n = 1 132)*	*18–64 years (n = 984)*	*25–64 years (n = 649)*
Hypertension, % (95% CI)	18.0 (16.5–19.6)	20.0 (18.4–21.8)	26.6 (24.4–28.9)	20.0 (17.8–22.3)	21.8 (19.5–24.3)	27.8 (24.9–30.8)	15.9 (13.9–18.1)	18.1 (15.8–20.6)	25.1 (21.9–28.6)
Diabetes, % (95% CI)	9.2 (8.1–10.4)	9.8 (8.6–11.2)	11.9 (10.3–13.6)	8.9 (7.4–10.6)	9.3 (7.8–11.2)	10.8 (8.9–13.0)	9.6 (8.0–11.4)	10.4 (8.7–12.5)	13.5 (11.0–16.3)
Hypercholesterolaemia, % (95% CI)	4.0 (3.2–5.0)	4.4 (3.5–5.5)	5.5 (4.4–6.9)	5.6 (4.3–7.2)	6.0 (4.7–7.8)	7.4 (5.7–9.5)	2.0 (1.2–3.2)	2.4 (1.5–3.8)	2.9 (1.8–4.8)

Table 3. Prevalence of hypertension and relation with other factors by gender (Caxito, 2016)

	All Participants (n = 2 354)	*Female (n = 1 222)*		*Male (n = 1 132)*	
Associated factor	*Prevalence % (95% CI)**	*Prevalence % (95% CI)**	*Adjusted OR[a, b] (95% CI)**	*Prevalence % (95% CI)**	*Adjusted OR[a, b] (95% CI)**
Total	18.0 (16.5–19.6)	20.0 (17.8–22.3)	–	15.9 (13.9–18.1)	–
Age (years)					
15–24	2.8 (1.9–4.2)	1.9 (0.9–3.9)	1	3.5 (2.2–5.6)	1
25–34	12.3 (9.9–15.2)	10.6 (7.7–14.6)	6.6 (2.8–15.4)	14.3 (10.8–18.8)	4.6 (2.6–8.2)
35–44	25.6 (21.5–72.0)	26.8 (21.4–32.9)	20.3 (8.9–46.5)	23.8 (17.7-31.2)	8.7 (4.7-16.0)
45–54	38.7 (33.4–44.4)	39.6 (32.8–39.6)	36.6 (16.0–83.8)	37.3 (28.8–46.6)	16.2 (8.7–30.0)
55–64	51.6 (45.0–58.2)	53.5 (44.9–61.9)	63.4 (27.1–147.9)	48.9 (38.7–59.1)	26.4 (13.9–50.0)
Residence					
Urban	15.9 (14.3–17.6)	17.6 (15.3–20.1)	–	14.0 (11.9–16.4)	–
Rural	26.9 (23.0–31.2)	30.0 (24.4–36.2)	–	23.5 (18.4–29.6)	–
Education (years completed)					
None	45.4 (38.9–52.0)	45.5 (38.8–52.4)	4.3 (1.8–10.2)	46.7 (24.8–69.9)	2.0 (0.6–6.5)
1–4	24.9 (21.4–28.7)	23.3 (19.5–27.6)	2.4 (1.0–5.4)	29.8 (22.5–38.4)	0.8 (0.5–1.5)
5–9	12.7 (10.8–14.9)	10.3 (7.8–13.6)	2.2 (0.9–5.1)	14.5 (11.8–17.7)	0.9 (0.6–1.4)
> 10	10.4 (8.2–13.1)	4.4 (2.1–8.8)	1	12.6 (9.8–16.1)	1
BMI class (kg/m^2)					
Underweight (< 18.5)	11.0 (7.8-15.3)	12.9 (8.1-19.0)	1	9.3 (5.5-15.2)	1
Normal (18.5–24.9)	15.2 (13.5–17.1)	17.0 (14.4–19.9)	1.1 (0.6–2.1)	13.7 (11.5–16.2)	1.3 (0.7–2.5)
Overweight (25.0–29.9)	25.8 (21.6–30.5)	23.9 (19.0–29.5)	1.2 (0.6–2.3)	29.2 (21.8–37.8)	2.2 (1.1–4.7)
Obese (≥ 30)	37.3 (30.2–45.0)	34.9 (27.2–43.4)	2.0 (1.0–4.1)	48.5 (32.5–64.8)	5.1 (1.9–13.4)
Abdominal obesity					
No	12.1 (10.6–13.7)	12.6 (10.5–15.2)	1	11.6 (9.7–13.7)	1
Yes	35.7 (31.9–39.6)	32.5 (28.3–37.0)	1.6 (1.2-2.3)	45.7 (37.7–54.0)	2.8 (1.8–4.3)
Tobacco smoking					
Non-current	17.3 (15.8–18.9)	18.9 (16.7–21.2)	–	15.5 (13.4–17.8)	–
Current	26.7 (20.2–34.4)	50.0 (34.1–65.9)	–	20.4 (14.0–28.7)	–
Alcohol consumption					
No consumpion	14.2 (12.6–16.1)	18.1 (15.7–20.9)	1	9.1 (7.2–11.6)	1
Occasional (< 3 days per week)	23.5 (19.8–23.5)	21.4 (16.7–27.1)	0.9 (0.6–1.4)	26.0 (20.4–32.5)	2.5 (1.6–4.0)
Frequent (≥ 3 days per week)	25.5 (21.5–25.5)	28.0 (21.1–36.2)	1.7 (1.1–2.7)	24.3 (19.6–29.7)	2.5 (1.7–3.9)

*Post-stratification weights used as described in the methods section.
[a]Adjusted for age (categorical: 15–23, 25–34, 35–44, 45–54, and 55–64).
[b]Only variables with relations with statistical significance shown.

Hypertension was higher among the obese (34.9% of women and 48.5% of men) and individuals with abdominal obesity (32.5% of women and 45.7% of men), with a higher OR in men for both conditions (Table 3). Hypertension prevalence was also higher among current smokers (50.0% in women and 20.4% in men) and frequent alcohol drinkers (28.0% in women and 24.3% in men). Men presented a higher OR for hypertension than women, related to the consumption of alcohol (Table 3).

Residents in urban areas presented a higher prevalence of diabetes, with a significantly higher OR for diabetes in men. Participants with lower education levels had a higher prevalence of diabetes, but without statistical significance (Table 4).

With regard to anthropometric variables, there was a higher prevalence of diabetes among obese participants (17.1% in women and 24.2% in men) and those with abdominal obesity (8.8% in women and 24.3% in men). Men with obesity (2.4 vs underweight) and abdominal obesity (2.3 vs no abdominal obesity) presented higher ORs for diabetes than women (2.1 for obese vs underweight and 1.5 for abdominal obesity) (Table 4).

For current smokers and occasional consumers of alcohol the prevalence of diabetes was higher, but with no significant relationship (Table 4). No significant relationships were found with education, residence, BMI, abdominal obesity, tobacco smoking and alcohol consumption; however, the prevalence of hypercholesterolaemia was higher among less educated individuals, the obese, smokers and frequent alcohol drinkers (Table 5).

The majority of the population (61.5%; n = 1 460) reported previous measures of blood pressure, and nearly half (48.5%) of the hypertensive participants were aware of their condition. Only 32.5% of the aware hypertensive participants were on treatment and 57.7% of them had their blood pressure controlled. This represented only 9.1% of all hypertensive participants (Fig. 1).

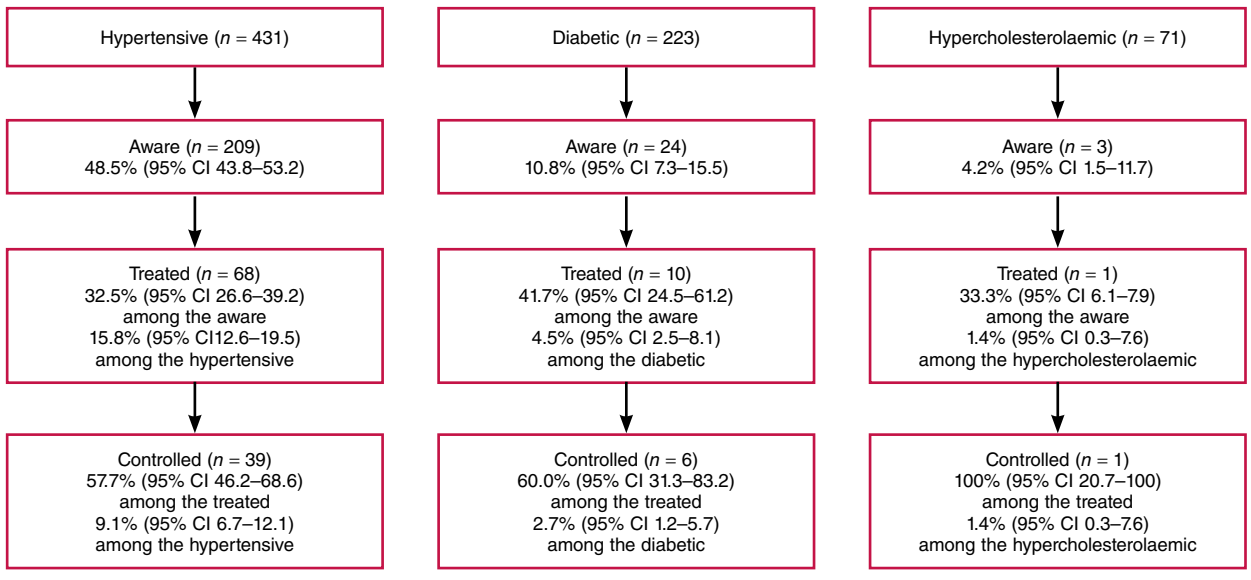
Only 7.3% (n = 172) of the population reported previous measurement of glycaemia, with a low awareness rate of 10.8% among participants with diabetes in this study. Of the aware participants, 41.7% were receiving treatment (4.5% of all hyperglycaemic participants) and 60.0% had a controlled blood sugar level (Fig. 1). Only 2.9% (n = 68) of participants reported previous measures of cholesterolaemia and only 4.2% of individuals with hypercholesterolaemia were aware of their condition (Fig. 1).

The hypertension awareness rate was higher among women (62.7%; 95% CI: 55.9–69.0) and older participants, without a difference regarding education level (Table 6). The diabetes awareness rate was higher among men (58.3%; 95% CI: 38.8–75.5), older participants and those with higher education levels (Table 7). The hypercholesterolaemia awareness rate was higher

Table 4. Prevalence of diabetes and relation with other factors by gender (Caxito, 2016)

	All participants (n = 2 348)	*Female (n = 1 220)*		*Male (n = 1 128)*	
Associated factor	*Prevalence % (95% CI)**	*Prevalence % (95% CI)**	*Adjusted OR[a,b] (95% CI)**	*Prevalence % (95% CI)**	*Adjusted OR[a,b] (95% CI)**
Total	9.2 (8.1–10.4)	8.9 (7.4–10.6)	1	9.6 (8.0–11.4)	1.4 (1.0–1.8)
Age (years)					
15–24	4.4 (3.2–6.0)	4.4 (2.7–7.0)	1	4.4 (2.9–6.6)	1
25–34	5.6 (4.0–7.7)	3.2 (1.8–5.9)	0.8 (0.3–1.7)	8.0 (5.4–11.6)	1.9 (1.0–3.5)
35–44	13.2 (10.2–17.0)	12.7 (9.0–17.7)	3.3 (1.7–6.2)	13.9 (9.3–20.3)	3.4 (1.8–6.5)
45–54	19.3 (15.2–24.2)	17.6 (12.9–23.7)	4.8 (2.6–9.0)	22.2 (15.4–30.9)	6.2 (3.3–11.6)
55–64	17.2 (12.8–22.8)	15.5 (10.3–22.7)	4.0 (2.0–8.0)	20.7 (13.5–30.4)	5.6 (2.8–11.0)
Residence					
Urban	9.8 (8.5–11.2)	9.2 (7.5–11.1)	1.6 (0.9–2.8)	10.4 (8.6–12.6)	2.6 (1.4–4.9)
Rural	6.8 (4.8–9.5)	7.4 (4.7–11.6)	1	6.0 (3.6–10.1)	1
Education (years completed)					
None	11.5 (7.9–16.5)	11.9 (8.1-17.1)	–	6.7 (1.2-29.8)	–
1–4	11.7 (9.2–14.6)	10.0 (7.5-13.3)	–	17.2 (11.5-24.9)	–
5–9	8.3 (6.7–10.1)	7.1 (5.1–9.9)	–	9.0 (6.9–11.6)	–
> 10	7.7 (5.9–10.2)	6.2 (3.4–11.1)	–	8.3 (6.1–11.3)	–
BMI class (kg/m^2)					
Underweight (< 18.5)	7.5 (4.9–11.4)	4.0 (1.7–9.0)	1	10.7 (6.6–16.9)	1
Normal (18.5–24.9)	7.8 (6.6–9.2)	7.7 (5.9–9.9)	2.0 (0.7–5.1)	7.9 (6.3–9.9)	0.7 (0.4–1.2)
Overweight (25.0–29.9)	12.4 (9.4–16.1)	10.4 (7.2–14.7)	2.4 (0.9–6.5)	16.5 (11.0–24.2)	1.1 (0.5–2.3)
Obese (≥ 30)	18.6 (13.4–25.4)	17.1 (11.5–24.5)	3.9 (1.4–11.1)	24.2 (12.8–41.0)	1.7 (0.6–4.5)
Abdominal obesity					
No	7.0 (5.9–8.3)	3.5 (2.3–5.2)	1	7.5 (6.0–9.3)	1
Yes	15.9 (13.1–19.0)	8.8 (6.4–12.2)	1.5 (1.0–2.3)	24.3 (17.9–32.0)	2.3 (1.4–3.8)
Tobacco smoking					
Non-current	8.8 (7.6–10.0)	8.6 (7.2–10.4)	–	8.9 (7.3–10.8)	–
Current	14.4 (9.6–21.0)	17.6 (8.3–33.5)	–	13.3 (8.2–20.8)	–
Alcohol consumption					
No consumption	8.9 (7.6–10.5)	8.7 (6.9–10.8)	–	9.2 (7.2–11.7)	–
Occasional (< 3 days per week)	10.5 (8.0–13.7)	10.1 (6.9–14.6)	–	11.0 (7.4–16.1)	–
Frequent (≥ 3 days per week)	8.8 (6.4–12.0)	8.3 (4.7–14.3)	–	9.1 (6.2–13.0)	–

*Post-stratification weights used as described in the methods section.
[a]Adjusted for age (categorical: 15–23, 25–34, 35–44, 45–54, and 55–64).
[b]Only variables with relations with statistical significance shown.



Post-stratification weights used as described in the methods section.

Fig. 1. Frequencies, awareness, treatment and control of hypertension, diabetes and hypercholesterolaemia.

Table 5. Prevalence of hypercholesterolaemia and relation with other factors by gender (Caxito, 2016)

	All participants (n = 1 781)	*Female (n = 978)*		*Male (n = 803)*	
Associated factor	*Prevalence % (95% CI)**	*Prevalence % (95% CI)**	*Adjusted OR[a,b] (95% CI)**	*Prevalence % (95% CI)**	*Adjusted OR[a,b] (95% CI)**
Total	4.0 (3.2–5.0)	5.6 (4.3–7.2)	2.3 (1.3–4.0)	2.0 (1.2–3.2)	1
Age (years)					
15–24	0.7 (0.3–1.8)	1.1 (0.4–3.2)	1	0.3 (0.1–1.9)	1
25–34	2.5 (1.4–4.3)	2.8 (1.4–5.7)	2.6 (0.6–10.8)	2.5 (1.1–5.3)	5.0 (0.8–31.6)
35–44	3.6 (2.0–6.4)	5.4 (2.9–9.6)	5.2 (1.4–20.0)	0.9 (0.2–4.7)	2.1 (0.2–24.4)
45–54	9.4 (6.3–13.7)	10.8 (6.9–16.7)	11.9 (3.30–42.7)	5.7 (2.5–12.8)	13.7 (2.1–88.1)
55–64	11.4 (7.6–16.8)	15.4 (10.0–23.0)	17.2 (4.8–61.9)	4.5 (1.6–12.5)	9.0 (1.2–69.5)
Residence					
Urban	3.9 (3.0–5.0)	5.6 (4.2–7.4)	–	1.8 (1.0–3.2)	–
Rural	4.2 (2.5–7.0)	5.3 (2.8–9.8)	–	3.5 (1.5–7.9)	–
Education (years completed)					
None	10.8 (7.0–16.2)	10.7 (6.9–16.3)	–	11.1 (2.0–43.5)	–
1–4	5.7 (3.9–8.3)	6.4 (4.3–9.5)	–	2.5 (0.7–8.8)	–
5–9	2.6 (1.7–4.1)	3.3 (1.9–5.9)	–	2.0 (1.0–3.9)	–
>10	2.0 (1.0–3.7)	2.3 (0.8–6.5)	–	1.9 (0.9–4.0)	–
BMI class (kg/m^2)					
Underweight (<18.5)	2.3 (0.9–5.7)	3.2 (1.1–9.1)	–	1.2 (0.2–6.5)	–
Normal (18.5–24.9)	3.5 (2.6–4.7)	5.1 (3.6–7.3)	–	1.9 (1.1–3.3)	–
Overweight (25.0–29.9)	5.3 (3.3–8.3)	6.0 (3.6–10.1)	–	3.8 (1.5–9.3)	–
Obese (≥ 30)	6.7 (3.5–12.2)	8.6 (4.6–15.5)	–	–[a]	–
Abdominal obesity					
No	2.4 (1.7–3.4)	3.5 (2.3–5.2)	–	1.5 (0.8–2.7)	–
Yes	8.1 (6.0–10.9)	8.8 (6.4–12.2)	–	5.9 (2.9–11.6)	–
Tobacco smoking					
Non-current	3.7 (2.9–4.8)	5.1 (3.9–6.7)	–	2.0 (1.2–3.3)	–
Current	6.4 (3.1–12.6)	17.9 (7.9–35.6)	–	2.5 (0.7–8.6)	–
Alcohol consumption					
No consumption	4.3 (3.2–5.6)	5.7 (4.2–7.7)	–	2.2 (1.2–4.1)	–
Occasional (< 3 days per week)	2.7 (1.4–5.0)	4.6 (2.5–8.6)	–	–[c]	–
Frequent (≥ 3 days per week)	3.9 (2.2–6.7)	5.6 (2.6–11.6)	–	2.5 (1.1–5.7)	–

*Post-stratification weights used as described in the methods section.
[a]Adjusted for age (categorical: 15–23, 25–34, 35–44, 45–54, and 55–64).
[b]Only variables with relations with statistical significance shown.
[c]No cases in this category.

Table 6. Awareness, treatment and control rates of hypertension by gender (Caxito, 2016)

	Awareness			*Treatment*			*Control*		
	All (n = 209) % (95% CI)	*Female (n = 131) % (95% CI)*	*Male (n = 78) % (95% CI)*	*All (n = 68) % (95% CI)*	*Female (n = 41) % (95% CI)*	*Male (n = 27) % (95% CI)*	*All (n = 39) % (95% CI)*	*Female (n = 25) % (95% CI)*	*Male (n = 14) % (95% CI)*
Education (years completed)									
none	21.5 (16.5–27.6)	34.4 (26.8–42.8)	0	17.6 (10.4–28.4)	26.8 (15.7–41.9)	3.7 (0.7–18.3)	10.3 (4.1–23.6)	16.0 (6.4–34.7)	0
1–4	31.1 (25.2–37.7)	40.5 (32.4–49.0)	15.4 (9.0–25.0)	27.9 (18.7–39.6)	39.0 (25.7–54.3)	11.1 (3.9–28.1)	25.6 (14.6–41.1)	40.0 (23.4–59.3)	0
5–9	28.2 (22.6–34.7)	22.1 (15.9–30.0)	38.5 (28.4–49.6)	29.4 (19.9–41.1)	26.8 (15.7–41.9)	33.3 (18.6–52.2)	33.3 (20.6–49.0)	36.0 (20.2–55.5)	28.6 (11.7–54.6)
> 10	19.1 (14.4–25.0)	3.1 (1.2–7.6)	46.2 (35.5–57.1)	25.0 (16.2–36.4)	7.3 (2.5–19.4)	51.9 (34.0–69.3)	30.8 (18.6–46.4)	8.0 (2.2–25.0)	71.4 (45.4–88.3)
Age (years)									
15–24	2.9 (1.3–6.1)	0.8 (0.1–4.2)	6.4 (2.8–14.1)	1.5 (0.3–7.9)	2.4 (0.4–12.6)	0	2.6 (0.5–13.2)	4.0 (0.7–19.5)	0
25–34	16.7 (12.3–22.4)	12.2 (7.7–18.9)	24.4 (16.2–34.9)	26.5 (17.4–38.0)	24.4 (13.8–39.3)	29.6 (15.9–48.5)	33.3 (20.6–49.0)	32.0 (17.2–51.6)	35.7 (16.3–61.2)
35–44	19.6 (14.8–25.5)	19.1 (13.3–26.7)	20.5 (13.0–30.8)	20.6 (12.7–31.6)	19.5 (10.2–34.0)	22.2 (10.6–40.8)	25.6 (14.6–41.1)	24.0 (11.5–43.4)	28.6 (11.7–54.6)
45–54	31.1 (25.2–37.7)	37.4 (29.6–45.9)	20.5 (13.0–30.8)	23.5 (15.0–34.9)	26.8 (15.7–41.9)	18.5 (8.2–36.7)	17.9 (9.0–32.7)	20.0 (8.9–39.1)	14.3 (4.0–39.9)
55–64	29.7 (23.9–36.2)	30.5 (23.3–38.9)	19.4 (19.4–39.0)	27.9 (18.7–39.6)	26.8 (15.7–41.9)	29.6 (15.9–48.5)	20.5 (10.8–35.5)	20.0 (8.9–39.1)	21.4 (7.6–47.6)

Table 7. Awareness, treatment and control rates of diabetes by gender (Caxito, 2016)

	Awareness			*Treatment*			*Control*		
	All (n = 24) %	*Female (n = 10) %*	*Male (n = 14) %*	*All (n = 10) %*	*Female (n = 6) %*	*Male (n = 4) %*	*All (n = 6) %*	*Female (n = 5) %*	*Male (n = 1) %*
Education (years completed)									
None	12.5	30.0	0.0	20.0	33.3	0	16.7	20.0	0
1–4	4.2	10.0	0.0	10.0	16.7	0	16.7	20.0	0
5–9	33.3	30.0	35.7	50.0	33.3	75.0	50.0	40.0	100.0
> 10	50.0	30.0	64.3	20.0	16.7	25.5	16.7	20.0	0
Age (years)									
15–24	8.3	20.0	0.0	20.0	33.3	0	33.3	40.0	0
25–34	12.5	10.0	14.3	10.0	16.7	0	16.7	20.0	0
35–44	20.8	10.0	28.6	20.0	16.7	25.5	16.7	20.0	0
45–54	25.0	20.0	28.6	10.0	16.7	0	0	0	0
55–64	33.3	40.0	28.6	40.0	16.7	75.0	33.3	20.0	100.0

Table 8. Awareness, treatment and control rates of hypercholesterolemia by gender (Caxito, 2016)

	Awareness			*Treatment*			*Control*		
	All (n = 3) %	*Female (n = 2) %*	*Male (n = 1) %*	*All (n = 1) %*	*Female (n = 1) %*	*Male (n = 0) %*	*All (n = 1) %*	*Female (n = 1) %*	*Male (n = 0) %*
Education (years completed)									
None	0	0	0	0	0	0	0	0	0
1–4	33.3	50.0	0	0	0	0	0	0	0
5–9	0	0	0	0	0	0	0	0	0
> 10	66.6	50.0	100.0	100.0	100.0	0	100.0	100.0	0
Age (years)									
15–24	0	0	0	0	0	0	0	0	0
25–34	0	0	0	0	0	0	0	0	0
35–44	33.3	50.0	0	100.0	100.0	0	100.0	100.0	0
45–54	66.6	50.0	100.0	0	0	0	0	0	0
55–64	0	0	0	0	0	0	0	0	0

among women (66.7%; 95% CI: 20.8–93.9), older age groups and higher education levels (Table 8). The treatment rate of all conditions was more prevalent in the older age groups and higher education levels, but the control rate was more frequent in younger participants.

Among the individuals who were aware of any of the three conditions, the advice most often given by healthcare professionals to follow non-pharmacological approaches for the management of cardiovascular risk factors was a change in dietary habits, with a decrease in salt and fat intake, and increased fruit and vegetable intake (Table 9).

Discussion

The prevalence of hypertension among participants in the range of 15 to 64 years old was 18.0%. This value rose to 26.6% among participants aged 25 to 64 years, which is slightly higher than those previously described for Angola over the last eight years,[14-15] particularly a study conducted in the same region in 2010,[16] and the WHO age-standardised (25 to 64 years old) estimated hypertension prevalence for 2014 in Angola of 23.9% (95% CI: 16.3–31.1).[1] More recently, a cross-sectional study conducted in Uganda, South Africa, Tanzania and Nigeria encountered an overall age-standardised prevalence of hypertension of 25.9%.[24]

The estimated 9.2% prevalence of diabetes (9.8% in urban and 6.8% in rural areas) was higher than previous reports from Angola of 5.7% among an urban population (aged 20 to 72 years) in 2010,[15] and 2.8% for a rural community (aged 30 to 69 years) in 2009.[17] The value of 9.8% estimated in individuals older than 18 years is in the middle range of prevalence levels encountered in STEPS surveys, with values from 3.0% in Benin to 22.5% in Niger.[25,26] This value also falls within the confidence intervals of the WHO estimate of 12.1% (95% CI: 5.6–18.9) for increased blood glucose levels in those over 18 years in Angola for 2014.[1]

This rise in diabetes is aligned with the global tendency for this disease, which has increased faster in LMIC than in high-income countries since 1980.[27] Since the end of the Angolan civil war in 2002, the population has been increasing and ageing. This, together with changes in food habits and the urbanisation process, may have led to the increased prevalence of diabetes in this region.

The prevalence of hypercholesterolaemia (5.3% among participants 25 and 64 years old) in this study was lower than that found in a previous study in Luanda among an older urban population.[15] However, this value falls within a wide range of values from several STEPS surveys measuring the prevalence of total cholesterol, from 2.1% in Mozambique to 26.0% in Tanzania.[25,26] This prevalence may also be tied to the ageing population and changes in dietary habits that most African countries are currently facing.[28] There is a lack of solid knowledge regarding the prevalence levels of hypercholesterolaemia in Africa, mainly owing to the difficulties in determining values of blood cholesterol in African communities because of the high cost of laboratory tests. This situation presents a challenge when comparing research results.

As described in other studies worldwide, the clustering of risk factors helps to explain the known impacts of age, education and obesity on the occurrence of hypertension, diabetes and hypercholesterolaemia. The prevalence of these three conditions was higher among individuals with less education, and increased with age and BMI.

Obesity represents a major concern as a risk factor for CVD and NCDs in general, and is connected with the current nutritional transition in Africa, with a shift in the composition and structure of diets traditionally low in fat and high in unrefined carbohydrates toward higher intakes of refined carbohydrates, added sugars, fats and animal-source foods.[28] This

Table 9. Non-pharmacological advice by health professionals to aware participants (Caxito, 2016)

Advice	*Hypertension (n = 209) % (95% CI)*	*Diabetes (n = 24) % (95% CI)**	*Hypercholesterolaemia (n = 3) % (95% CI)**
Reduce salt in your diet	78.5 (72.4–83.5)	100.0	100.0
Reduce fat in your diet	61.7 (55.0–68.0)	91.7	66.7
Eat at least five servings of fruit and/or vegetables each day	58.4 (51.6–64.8)	70.8	66.7
Reduce or stop alchool consumption	51.2 (44.5–57.9)	83.3	33.3
Start or do more physical activity	34.4 (28.3–41.1)	75.0	66.7
Quit using tobacco or don't start	31.1 (25.2–37.7)	45.8	0
Maintain a healthy body weight or lose weight	30.1 (24.3-36.7)	75.0	66.7

*Due to the small sample size, the 95% CI was not determined.

shift may have had an impact on the rise in incidence of diabetes over the past decades, revealed in recent literature reviews,[29-31] as well as a WHO estimation of the rise in median prevalence of elevated total cholesterol for this region.[2]

Similar to this nutritional transition, the process of urbanisation underway in the region must be taken into consideration for future interventions. Living in an urban area has been associated with a two-fold increase in the prevalence of diabetes among this population, as described in other studies.[1,29-31]

Information regarding the awareness, treatment and control rates for the three conditions investigated is scarce for the African continent, except for hypertension; there are also some available data with regard to diabetes. Our findings for awareness of hypertension were higher than those calculated in 2010 for Africa, with an estimated 33.7% pooled awareness rate.[32] Current values for awareness, treatment and control of hypertension are higher than in 2011 in the same population; results for awareness were 21.6% (95% CI: 17.0–26.9) in 2011 and 48.5% in the present study. Values for participants who were aware of their condition and on pharmacological treatment (13.9%, 95% CI: 5.9–29.1) increased to 32.5%; approximately one-third of participants were controlled in 2011 and more than half were controlled in our study. This may have resulted from the positive effect of identification of hypertensive individuals and medical follow up after the first survey in 2011.

Nonetheless, the levels of awareness about hypertensive status are still low, a situation common in Africa,[33] with levels much lower than those in North America and Europe.[34] A similar framework exists for diabetes awareness in Africa, with fewer than 50% of participants in one study aware of their condition.[29] No data were found for awareness of total cholesterol levels.

The lack of primary healthcare facilities in this region, especially in rural areas, makes the low levels of previous measurements plausible. Furthermore, the current training of Angolan health professionals and the availability of clinical equipment are still focused on infectious diseases, not considering CVD a priority. Therefore initiatives promoting the awareness of CVD are lacking in the region, and proper monitoring of patients' conditions does not occur.

Moreover, the information available to the population is not enough to convince patients to take lifelong medication in order to treat a condition, which is usually asymptomatic. Only one-third of participants with any of these conditions had access to treatment, which demonstrates the inadequacy of the region's health system to help patients manage risk factors. Economic difficulties and the lack of drugs to address CVD may also help explain the low levels of treatment and control found.

Nevertheless, a positive note should be made as to the number of patients who had controlled levels of blood pressure, blood sugar and cholesterolaemia in this specific population. Considering that they were younger and better educated, they could have had easier access to drugs and health facilities. Also noteworthy, in the absence of access to drugs, physicians' advice in most cases is to adopt non-pharmacological approaches to reducing modifiable risk factors, mainly associated with diet.

Strengths and limitations of the study

Our study findings should be interpreted cautiously because the Dande-HDSS was developed as a district-level surveillance system in an urban and rural setting and is therefore not representative of the demographic structure of the country. In addition, age groups over 65 years old (known for higher rates of the conditions studied) were not considered owing to their low representation in the general structure of the population (3.6% of the Dande-HDSS population),[18] which is a common practice for surveys conducted in sub-Saharan Africa.

Internal migration and the geographical isolation of some hamlets within the Dande-HDSS, together with the fact that working individuals were unavailable during the daytime,[17] were reflected in the sampling definition, with a 30% non-participation rate. The distribution of non-respondents was uneven, with a higher proportion of younger people and men (data not shown). This may have caused instability in the estimates in some strata.

Participants were requested not to eat anything eight hours before participating in the study; however, it was difficult to measure adherence to this request, which adds uncertainty to the measures of blood glucose and cholesterol. We used dry chemistry devices to measure glycaemia and cholesterolaemia, but owing to high temperatures and humidity during field surveys, data collection was not possible in some cases, causing a higher number of missing data than expected.

Due to the many variables covered in the survey and to avoid drop-out of participants in future rounds, additional questions relating to awareness, pharmacological treatments and non-pharmacological approaches were conducted in a more detailed form in individual follow-up visitations. These are not dealt with extensively in this article. Also the low number of aware individuals and consequently under-treatment limited the statistical analysis of data regarding these aspects.

It is therefore not possible to extrapolate our findings to a larger population at country level. However, this study reveals new data about the prevalence, awareness, treatment and control of diabetes and hypercholesterolaemia, and it is the most comprehensive community-based study conducted to date in Angola.

Future direction

The inclusion of younger participants (15 to 24 years) allows a better representation of the demographic structure of the country and creates a baseline for future surveys. The emphasis for future interventions should be aimed at younger populations in which the prevalence of major risk factors is still low, so as to make a difference in the long term.

In all LMIC, NCDs are the leading cause of death and disability, killing nearly eight million people under 60 years old in 2013.[25] Over the past decade, the focus of assistance in these countries has primarily addressed maternal and child health and infectious diseases. Without setting these aside, there is an opportunity to use structures that are already in place, to maximise resources. The international community should consider expanding the mandate of current programmes to include outcome-orientated measures for improving general health and lifestyles.

Many of the methods of NCD prevention, management and treatment, which are responsible for the decline in some of these diseases in high-income countries, are inexpensive but are not widely used in LMIC. These methods could be implemented through established global health strategies, such as increased

use of low-cost drugs,[35] and improved access to NCD services for young adults and people with low educational attainment.[36]

Conclusions

This report reinforces the available data for the main CVD risk factors in Angola and helps to build the basis for further prospective studies, especially among the younger group in this region. We provide the first evidence that hypertension prevalence is rising, together with diabetes, when compared with previous studies in the region.

Despite being a growing economy, Angola's primary health system may not be currently able to provide an adequate answer to the changing health needs of this population. A gradual shift from infectious diseases to NCDs is underway and this puts additional stress on the reinforcement of primary care intervention in the region.

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4.3. Paper IV - Smoking and nicotine dependence

Pedro JM, Brito M, Barros H.

Tobacco consumption and dependence in Bengo Province, Angola: a community-based survey.

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RESEARCH ARTICLE

Tobacco consumption and nicotine dependence in Bengo Province, Angola: A community-based survey

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Abstract

There is concern about the potentially increasing use of tobacco in Angola. However, information on the frequency and determinants of this use is not systematised. This study aimed to estimate the prevalence of tobacco consumption and nicotine dependence among smokers in an Angolan population and considering individual socio-demographic and behavioural characteristics. A community-based survey with 2,472 respondents (age range: 15–64 years) was conducted in 2013–2014 in the country's Bengo Province. The collection methodology for assessing each type of tobacco consumption and its daily quantification followed the World Health Organization STEPwise approach to chronic disease risk factor surveillance. The Fagerström Test for Nicotine Dependence was also used to assess smokers. Mean values for prevalence of tobacco use and nicotine dependence were estimated by sex and by previously defined variables. Daily smoking (6.1%) was found to be higher for males (10.0%) them among females (2.6%), and the amount of ex-smokers (7.5%) was higher them smokers. Only 0.2% of those surveyed reported use of smokeless (chewing) tobacco. One-third of ever-smokers reported having started smoking daily before age 18. Nicotine dependence levels were classified as very low or low in 83.6% of the smokers. Daily smoking prevalence increased with age, and was higher in rural areas and among individuals with no formal education, lower incomes, and alcohol consumption. This population presented a low smoking prevalence, along with a low number of daily smoked cigarettes and low levels of nicotine dependency, despite the low prices of, and easy access to, manufactured cigarettes. These two factors conjugated with the current absence of an Angolan policy for tobacco control, enhance the susceptibility for rising overall tobacco use in the near future.

Introduction

Tobacco is a major risk factor for multiple non-communicable diseases (NCDs), including cancer, chronic lung diseases, and cardiovascular diseases. Tobacco use presently accounts for around seven million deaths every year worldwide [1], and this is projected to increase to eight

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million by 2030 [2]. A 30% relative reduction until 2025 in the prevalence of current tobacco use in people aged 15 years or older is one of the nine voluntary global targets defined to reduce the preventable and avoidable burdens of morbidity, mortality, and disability due to NCDs [3].

Low- and middle-income countries are facing increased in tobacco use, while the opposite is occurring in high-income countries [4,5,6]. It is also estimated that nearly 80% of the world's tobacco smokers are from low- or middle-income countries [7].

Although information on the prevalence, trends, patterns, and determinants of tobacco use is still limited for sub-Saharan Africa [8,9], there is evidence of increasing use in some countries [9]. Smoking is expected to increase in the region as a result of the tobacco industry's strategy of creating new consumers to offset the declines in traditional markets [10,11].

In Angola, which ratified the Framework Convention on Tobacco Control in 2007, there is no national survey on tobacco consumption, and the defined policies in the convention that aim at effective tobacco prevention and control have not been fully implemented, especially regarding smoke-free environments, taxation, health warnings on tobacco product packages, and bans on advertising, promotion, and sponsorship of such products [12,13,14]. The leading causes of mortality and morbidity in Angola are communicable, maternal, neonatal, and nutritional diseases, but the rates of premature deaths due to NCDs are rising [15]. The urbanization process and westernization of life habits in Africa is followed by increased exposure to behavioural risk factors for NCDs, such as alcohol consumption and tobacco use [3,4].

Tobacco, one of Angola's major industries, was established in the country during the Portuguese Colonial War (1961–1974) and has experienced 400% growth since 2002, although there are no tobacco plantations or manufacturing industries in the country [16]. The going market price for a pack of 20 cigarettes is around $1, and since 2009, British American Tobacco has held a monopoly in the country's tobacco industry [14,16].

There is concern about the increasing use of tobacco in Angola following rapid economic growth, given the low prices for tobacco products and in the absence of restrictive legislation or organized health promotion campaigns. However, there is scarce information on the frequency and determinants of tobacco use in representative samples, further limiting health plan efforts and evaluation of interventions. The present study is the first report on the use of tobacco and the level of nicotine dependence among smokers in a large Angolan community sample of people aged 15–64 years.

Materials and methods

Results presented herein were extracted from a community-based survey conducted in the catchment area of the Dande Health and Demographic Surveillance System (Dande HDSS) [17], located in the Dande Municipality of Bengo Province, between 18 September 2013 and 28 March 2014. This study, named CardioBengo, constituted a larger survey of cardiovascular risk factors [18], and was based on the World Health Organization STEPwise approach to Surveillance (STEPS) to Chronic Disease Risk Factor manual (core and expanded version 3.0) [19].

Sample characterization

The CardioBengo baseline survey was created and implemented with a representative sex- and age-stratified random sample of the Dande HDSS population aged 15–64 years as its basis [18]. Those aged 65 and older were not included because of their low representation in the general population (only 3.6% in the Dande HDSS) [17]. Younger participants (15–24 years)

allowed a better representation of the demographic structure and created a stronger baseline for future surveys.

A total of 3,515 individuals were selected. After two failed attempts to contact them at their homes on different hours on weekdays, 1,025 were considered unreachable and six refused to participate, resulting in a final sample of 2,484 individuals. From these, 12 were excluded from the final analysis herein because of missing information on tobacco variables; thus, the final sample was 2,472.

Study variables

Information on sex, age, education, family income, and alcohol consumption was collected through interviews [18,19] conducted by trained interviewers in Portuguese, and if necessary in the local language of Kimbundu. For analysis, age was categorized into five 10-year groups: 15–24, 25–34, 35–44, 45–54, or 55–64. Education was categorized by number of completed years of school: none, 1–4, 5–9, or 10 or more. Monthly family income was recorded in the Angolan kwanza, which then was converted into US dollars and categorized into: none, $150 or less, $151–299, or $300 or more. Frequency of consumption of alcoholic beverages during the preceding 12 months was recorded as: none, daily, 5–6 days/week, 1–4 days/week, or 1–3 days/month. Area of residence (urban or rural) was classified as described for the Dande HDSS area [17].

Assessment of tobacco use and nicotine dependence

Subjects were asked if they currently use or had ever used any type of tobacco (smoked or smokeless), their age at initial use, current use, and average consumption. For analysis, individuals were classified as current, ex-, and never-users. Current users were asked about the type of tobacco used: manufactured, hand-rolled, and/or smokeless. Smokers (manufactured and/or hand-rolled cigarettes) were further grouped by frequency of consumption ($\geq$1 and $<$6, $\geq$6 and $<$20, or $\geq$20 cigarettes/day).

A validated version of the Fagerström Test for Nicotine Dependence, in Portuguese [20], was also integrated into the interview. Per the test, nicotine dependence score was categorized as 0–2: very low; 3–4: low; 5: medium; 6–7: high; or 8–10: very high.

Statistical analysis

Data were entered twice into a PostgreSQL (University of California, Berkeley, CA, USA) database and imported into IBM SPSS Statistics for Macintosh, Version 23.0 (IBM Corp., Armonk, NY, USA) for statistical analysis. All analyses were conducted considering the sampling weights [18]. Descriptive data are reported as absolute frequencies and percentages, and mean and standard deviation (SD) when appropriate. Prevalence of tobacco use and its 95% confidence interval (95% CI) were calculated according to the socio-demographic and behavioural characteristics.

Ethics

All procedures performed in this study were in accordance with the standards of the 1964 Declaration of Helsinki and its later amendments. The Ethics Committee of the Angolan Ministry of Health approved the CardioBengo study protocol and all use of secondary data. Written informed consent was obtained from each participant or from the parent or legal guardian of those under 18 years old. A copy of the signed consent form, as well as contact information, was subsequently delivered to each participant.

Results

As shown in Table 1, the great majority of the participants reported never using any type of tobacco (86.1% overall: 94.1% of females, 77.5% of males). The prevalence of current smoking was 6.1%, and was higher among males (10.0%) than females (2.6%), and the prevalence of ex-smokers was 7.5% (12.2% in males and 3.2% in females). Only five participants reported use of smokeless (chewing) tobacco (0.2%, 95% CI: 0.1–0.5).

Around one-third of ever-smokers (current and ex-) began smoking before age 18 (Table 1). The average age at initiation was 20.1 (±6.9) years; 19.8 (±6.1) years for males and 21.4 (±9.3) for females. None of the current smokers reported intermittent use, with most reporting five or fewer cigarettes per day (84.8% of females, 59.7% of males) (Table 1). The average number of daily smoked cigarettes was 6.6 (±6.8), higher among males (7.5 ± 7.2) than females (3.4 ± 3.3).

The nicotine dependence level was rated very low or low in 83.6% of the smoker population. Only 9.1% of females presented a medium level and none were above, while 18.4% of males had a medium or higher level (Table 1). Table 2 shows a breakdown of the mean values of nicotine dependence by variable categories, revealing that males had consistently higher levels of dependence than females. Among males, younger individuals presented a slightly higher mean value, as with males from urban areas or who reported daily alcohol consumption. Among females, the highest values of mean nicotine dependence were found in rural areas and among women aged above 45 years (Table 2).

As shown in Table 2, the prevalence of smoking was highest in the 55–64 age group for both sexes. The rural area had a higher smoking prevalence. Participants with 10 or more years of education had the lowest prevalence in both sexes. The prevalence was similar among income categories but slightly higher for those with lower levels of family income. Those who consumed alcohol (especially daily users) presented a higher prevalence of smoking. Similar trends were found for ex-smokers (Table 2).

Table 1. Prevalence, characteristics of tobacco use and nicotine dependence in smokers, by gender.

	Total (*n* = 2,472)		Female (*n* = 1,283)		Male (*n* = 1,189)	
	n	**% (95% *CI*)***	***n***	**% (95% *CI*)***	***n***	**% (95% *CI*)***
Tobacco use						
Never	2,129	86.1 (84.7–87.4)	1,207	94.1 (92.6–95.2)	922	77.5 (75.1–79.8)
Smokeless	5	0.2 (0.1–0.5)	2	0.2 (0.0–0.6)	3	0.3 (0.1–0.7)
Current smokers	152	6.1 (5.3–7.2)	33	2.6 (1.8–3.6)	119	10.0 (8.4–11.8)
Ex-smokers	186	7.5 (6.5–8.6)	41	3.2 (2.4–4.3)	145	12.2 (10.5–14.2)
Uptake below the age of 18	113	34.7 (29.7–40.0)	27	39.7 (28.9–51.6)	86	33.3 (27.9–39.3)
Daily smoked cigarettes (manufactured or hand-rolled)						
≥1 and <6 cigarettes/day	99	65.1 (57.3–72.3)	28	84.8 (69.1–93.3)	71	59.7 (50.7–68.0)
≥6 and <20 cigarettes/day	36	23.7 (17.6–31.0)	4	12.1 (4.8–27.3)	32	26.9 (19.7–35.5)
≥20 cigarettes/day	17	11.2 (7.1–17.2)	1	3.0 (0.5–15.3)	16	13.4 (8.4–20.7)
Nicotine Dependence (Fagerström Test)[a]						
Very low dependence (0–2)	77	50.7 (42.8–58.5)	17	51.5 (35.2–67.5)	60	50.4 (41.6–59.2)
Low dependence (3–4)	50	32.9 (25.9–40.7)	13	39.4 (23.2–56.3)	37	31.1 (23.5–39.9)
Medium dependence (5)	16	10.5 (6.6–16.4)	3	9.1 (3.1–23.6)	13	10.9 (6.5–17.8)
High dependence (6–7)	8	5.3 (2.7–10.0)	0	-	8	6.7 (3.4–12.7)
Very high dependence (8–10)	1	0.7 (0.1–3.6)	0	-	1	0.8 (0.1–4.6)

* post-stratification weights used as described in the methods section.

[a] only determine for cigarette smokers.

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Table 2. Prevalence of smoking and ex-smoking by socio-demographic caracteristics and alcohol consumption frequency, by gender.

Sociodemographic characteristics	Female			Male		
	Current Smokers (*n* = 33)	Ex-Smokers (*n* = 41)	Nicotine Dependence (*n* = 33)	Current Smokers (*n* = 119)	Ex-Smokers (*n* = 145)	Nicotine Dependence (*n* = 119)
	% (95% *CI*)*	% (95% *CI*)*	Mean ± SD	% (95% *CI*)*	% (95% *CI*)*	Mean ± SD
Age						
15–24 years	-[a]	0.3 (0.0–1.4)	-[a]	3.4 (2.1–5.3)	5.8 (4.0–8.1)	3.0 ± 2.3
25–34 years	0.9 (0.3–2.6)	-[a]	2.3 ± 0.6	10.0 (7.2–13.9)	8.4 (5.8–12.0)	2.9 ± 1.9
35–44 years	2.5 (1.2–5.4)	3.8 (2.0–7.0)	1.6 ± 1.4	17.6 (12.5–24.3)	15.6 (10.8–22.0)	2.6 ± 1.9
45–54 years	6.8 (4.0–11.3)	7.9 (4.8–12.6)	2.7 ± 1.4	17.4 (11.6–25.1)	30.6 (23.1–39.3)	2.7 ± 1.8
55–64 years	9.9 (5.9–16.2)	13.0 (8.3–19.8)	2.4 ± 1.3	25.8 (18.1–35.3)	29.9 (21.7–39.6)	2.3 ± 1.9
Place of residence						
Rural	5.3 (19.8–31.0)	2.4 (1.1–5.2)	3.0 ± 0.9	25.0 (19.8–31.0)	15.4 (11.2–20.6)	2.3 ± 1.9
Urban	2.1 (5.3–8.5)	3.4 (2.4–4.7)	2.0 ± 1.5	6.8 (5.3–8.5)	11.4 (9.6–13.6)	3.0 ± 2.2
Education						
none	12.0 (8.2–17.1)	12.9 (9.0–18.1)	2.5 ± 1.4	29.4 (13.3–53.1)	18.8 (6.6–43.0)	2.0 ± 2.2
1–4 years	1.6 (0.8–3.2)	2.5 (1.4–4.4)	1.5 ± 2.6	33.1 (25.7–41.5)	21.2 (15.1–28.9)	3.2 ± 2.6
5–9 years	0.2 (0–1.2)	0.7 (0.2–1.9)	2.5 ± 2.1	11.3 (9.0–14.1)	13.7 (11.1–16.7)	2.4 ± 1.8
≥10 years	-[a]	0.6 (0.1–3.4)	-[a]	1.5 (0.7–3.1)	7.5 (5.4–10.2)	2.5 ± 1.4
Monthly Family Income						
No income	5.0 (2.0–12.2)	5.0 (2.0–12.2)	1.6 ± 1.3	15.2 (6.7–30.9)	18.8 (8.9–35.3)	3.0 ± 2.0
≤150 USD	3.0 (1.7–5.1)	3.7 (2.3–6.0)	2.7 ± 1.6	14.9 (11.0–20.0)	18.6 (14.2–24.0)	2.1 ± 1.9
151–299 USD	1.9 (0.8–4.9)	2.9 (1.3–6.2)	1.4 ± 1.8	13.6 (9.4–19.3)	13.6 (9.4–19.3)	3.4 ± 2.3
≥300 USD	2.1 (0.4–11.1)	2.1 (0.4–11.1)	2.0 ± 0.0	10.0 (6.2–15.8)	16.7 (11.6–23.4)	3.0 ± 1.5
Alcohol consumption						
No	1.4 (0.8–2.4)	3.0 (2.1–4.4)	2.5 ± 1.3	5.2 (3.8–7.2)	10.4 (8.3–13.0)	2.7 ± 1.7
Yes	5.4 (3.5–8.1)	3.3 (2.0–5.6)	2.2 ± 1.3	17.2 (14.2–20.8)	15.0 (12.2–18.4)	2.6 ± 1.3
Alcohol consumption frequency						
Daily	16.0 (6.4–34.7)	4.2 (0.7–20.2)	1.8 ± 0.9	25.9 (16.1–38.9)	18.5 (10.4–30.8)	3.5 ± 2.6
5–6 days per week	4.2 (1.2–14.0)	2.1 (0.4–11.1)	1.5 ± 2.6	12.7 (8.3–18.9)	16.6 (11.5–23.3)	2.7 ± 2.0
1–4 days per week	4.6 (2.6–7.8)	3.4 (1.8–6.4)	2.4 ± 1.4	19.4 (14.9–24.7)	14.1 (10.3–19.0)	2.3 ± 1.8
1–3 days per month	7.3 (2.9–17.3)	5.4 (1.8–14.6)	2.2 ± 1.3	9.8 (4.3–21.0)	11.5 (5.4–23.0)	2.9 ± 2.2

* post-stratification weights used as described in the methods section.

[a] No individuals in this category

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Discussion

The analysis of the results from this survey contributes to the small body of tobacco-use-related literature on Angola. Quite recently, the Global Burden of Disease Study (GBD) estimated a smoking prevalence of 1.6% in females and 14.2% in males for Angola in 2015 [6].

Without a national prevalence survey, only a subnational survey from Huambo Province was conducted under the auspices of the World Health Organization in 2010, and in a sample aged 13–15 years found a 2.3% prevalence of smoking (3.2% in boys, 0.3% in girls) [21]. Three other studies published since 2000 provided data on tobacco smoking: a survey of 667 adult students of health sciences in Lubango estimated a prevalence of 4.0% [22]; a study conducted on 615 active employees of the University Agostinho Neto, Luanda, found a value of 7.2% (10.2% in males, 4.4% in females) [23]; and in 1,464 individuals aged 25–64 years, surveyed in

2011 for hypertension in the same area as in the present study, the prevalence was 9.8% (18.3% in males, 4.3% in females) [24].

To integrate our results with the GBD estimation and these four studies, it was necessary to look at the age range of each. This survey included individuals aged 15–64 years, and none of the above surveys had such a wide age range. The two with younger populations—Huambo and Lubango [21,22]—had lower prevalence (2.3% and 4.0%, respectively), and the two with older populations—Luanda and Bengo [23,24]—were higher (7.2% and 9.8%, respectively). This situates the present findings in the middle, at 6.1%.

Smoking prevalence estimates present vast heterogeneity among countries in the sub-Saharan Africa region [25,26]. National estimates for those countries, mainly after STEPS surveys, ranged from 1.8% in Zambia to 37.7% in Sierra Leone [11,25,27]. In this way, the present results evidently place Angola low in prevalence rankings for the region.

A commonality between the present study and the rest of the Angola-based studies regarding tobacco is that the prevalence of current smoking has been consistently higher among males than females. Smoking is the preferred type of tobacco consumption for males when compared with females [26,28]. As in other populations, smoking among females was significantly less prevalent, across all socio-demographic characteristics [26–29]. Culturally, female smokers are not generally well accepted [29], and use of smokeless tobacco is more frequent among females than males in Sub-Saharan Africa [28]. However, social changes and economic growth in Angola may reflect females' empowerment, including more equitable access to income and educational opportunities and, therefore, accompanied by shifts in societal suitability and acceptance of female smokers [29].

The rural areas have a higher proportion of smokers them the urban areas in this survey, while it is more common to encounter greater prevalence of smokers in urban areas of sub-Saharan African countries [27,30]. The region where the survey was conducted is only 60 km from the capital. It serves as a commercial post between the capital and the northern cities, and in this way may influence the publicity of tobacco in rural areas located near major roads to other provinces.

The relation between smoking and education level, with a higher prevalence of smokers among the less-educated, who may lack health literacy to critically evaluate their decisions regarding tobacco use [7,31], is common in other African surveys. Low levels of family income are usually associated with low levels of education, and indeed the prevalence of smokers was also higher among low-income individuals in the present study. This reveals a higher level of exposure among the population's more disadvantaged groups, which further contributes to inequalities in health promotion.

Together with the economic difficulties that youth show as a reason for not smoking in Angola [14], the long period of colonial and civil war (1961–2002) may have strongly influenced the higher prevalence among older groups and the initiation age of the majority of the individuals. This evidence is reinforced by the prevalence of ex-smokers among older people and the duration of smoking habits that correspond with normal years of active military duty. This phenomenon of smoking, together with alcohol consumption and the use of other drugs among populations from regions with armed conflict is described in other studies, and often associated with rituals of manhood and integration in armed groups [32,33].

This connection associated with the higher prevalence of current and ex-smokers in the groups of less-educated and less-wealthy males and females must be acknowledged and further studied with qualitative approaches that enable understanding of the impact of war and post-traumatic stress on tobacco and alcohol consumption patterns in Angola. This accumulation of behavioural risk factors, which occurs in this population, must be a concern focused on in future interventions addressing addiction and health education.

With regard to addiction, the present results revealed that low nicotine dependence levels were still predominant in this population, with low mean numbers of cigarettes smoked daily (3.4 in females and 7.5 in males). The efficacy of individual smoking cessation strategies can be improved by considering the target group's nicotine dependence level [34].

The low rates of smoking prevalence and nicotine dependence among smokers, and the substantial rate of ex-smokers, can be associated with individuals' weighty economic difficulties and the end of the war period. Angola has never had a legal framework for tobacco control; this is now predicted in the national plan for health development for 2012–2025 [14]. There are also absolutely no cessation programs or health promotion initiatives that specifically target tobacco use. This owes to the inadequacy of health structures and lack of health professionals trained in this subject, as identified by the Ministry of Health [14].

Strengths and limitations

The present study findings need to be interpreted cautiously, as the Dande HDSS was designed as a district-level surveillance system. Even if it reflects the national demographic structure of Angola in 2014 (young population with 50.3% aged 15–64 years, 51.5% females, and 68% concentrated in urban areas) [35], the goal herein was not to infer at a country level. This cross-sectional survey only covered a relatively short time period and could not capture possible cycles of temporary migration. Variables were also self-reported, which may have resulted in self-report bias and reflected social desirability. Additionally, information on real household constitution was not available, making the family income a possibly biased proxy of the participants' economic power.

Migration and geographical isolation of some settlements within the Dande HDSS, together with the fact that working individuals were unavailable during the daytime [17], were reflected in the sampling definition, with a predictable 30% nonparticipation rate [18]. The distribution of non-respondents was uneven, with a higher proportion among younger individuals and males; this may have caused imbalance in the estimates in some strata.

However, this study is part of the largest community-based survey of NCD risk factors in Angola, as the first to address nicotine dependence in smokers in the general population. It is also expected to provide a baseline for further evaluating trends in tobacco use and understanding the dynamics in this population.

Conclusions

This population, such as others in sub-Saharan Africa, is in the early stages of a possible tobacco epidemic, is characterized by low rates of smoking and increasing use of cigarettes among males [26,27]. However, and differently from high-income countries, the more educated and wealthier males do not seem to be those initially affected by the epidemic; the poorer and less-educated show higher smoking prevalence.

Tobacco use in Africa is on the rise as the tobacco industry shifts its marketing focus from the West to areas in Africa and Asia seen as having strong market growth potential [10,11,36]. Increasing urbanization and globalization, together with non-existent policies for tobacco control in Angola, and low product prices, enhance the susceptibility to higher levels of tobacco use in the near future.

Mass media campaigns and taxation of tobacco products, as proposed in the WHO Framework Convention on Tobacco Control [12,13,36], together with the expected implementation of tobacco control laws, may counteract the expected rising of smoking prevalence in Angola while tobacco use is still relatively low.

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4.4. Paper V - Prevalence of underweight and obesity

Pedro JM, Brito M, Barros H.

Gender and socio-demographic distribution of body mass index: the nutrition transition in an adult Angolan community

Journal of Public Health in Africa [Submitted]

Abstract

This cross-sectional survey with 2,357 subjects aged 15 to 64 years from a rural-urban community in Bengo Province, Angola, aimed to evaluate the gender differences in the prevalence of body mass index categories and how socio-demographic characteristics influence it. Women presented a significantly higher prevalence of obesity (10.5% versus 2.8%) but the underweight frequency was similar to men (10.2% versus 12.4%). Overweight and obesity increased with age, with underweight being more prevalent in the age group 15 to 24 years. Obesity was more prevalent among individuals living with a companion (in a marital relation), decreased with education (in women), but was higher in rural areas, and for those with a higher family monthly income, in both genders. The prevalence of obesity and underweight were similar in women, reflecting a nutrition transition state. Like in other African communities, women present a higher prevalence of overweight and obesity them men, but the values of underweight are similar between genders. This stresses the need of designed health interventions for women, to face the double burden and accumulation of risk factors in women.

Keywords: Sub-Saharan Africa, Underweight, Obesity, Prevalence, Nutritional transition.

Introduction

Overweight and obesity are major public health problems, consistently associated with increased risk of non-communicable diseases (NCD).[1] Between 1980 and 2013 the proportion of adults with overweight and obesity increased worldwide, from 28.8% to 36.9% in men and from 29.8% to 38.0% in women,[2] a phenomenon observed in all regions of the world.[1-5] However, the other extreme of body mass index (BMI), underweight, remains an important social and health threat, associated with increased risk of morbidity and mortality,[1,7] and it is only slowly decreasing in Africa.[6]

Sub-Saharan Africa (SSA) faces a demographic and epidemiologic transition.[8-11] Urbanization, sedentary lifestyles and nutritional changes towards westernized diet, high in sugar and fats, led to an increased obesity and NCD prevalence that coexists with the burden of communicable diseases.[8-13] This dual burden presented in national vital statistics also reflect potential inequalities at the level of households, with gender or generation differences in food allocation related to social norms.[10]

Angola faces an increase in premature deaths caused by NCD and high rates of maternal and child mortality due to infectious diseases,[14] as described by the early stage of the nutrition transition.[9] One child in twelve does not survive to the age of five,[15] with malnutrition as an underlying cause of most deaths, with 38.0% of children stunted and 15.6% underweight.[16] However, data on gender, poverty, and health related issues is lacking in the country.[17]

In this report, we present the prevalence of BMI categories in 15 to 64 years-old inhabitants of a well-defined community of Angola, evaluating its distribution according to gender and socio-demographic characteristics.

Methods

The results shown in this paper where extract from a community-based survey conducted in the catchment area of the Dande - Health Demographic Surveillance System (Dande-HDSS), located in the Dande Municipality, in Bengo Province, Angola.[18]

A representative sex- and age-stratified random sample of the Dande-HDSS population (60,075 people) was drawn to constitute the baseline of a large prospective survey on cardiovascular risk factors, the CardioBengo.[19] Participants were evaluated following the published protocol,[19] based on the World Health Organization (WHO) STEPwise approach to

Surveillance (STEPS) to Chronic Disease Risk Factor manual (core and expanded version 3.0).[20]

A total of 2484 individuals (15 to 64 years old) were evaluated between September 2013 and March 2014. We excluded 116 pregnant women due to the fact that anthropometric parameters vary during pregnancy, and 11 individuals with missing data on anthropometric measurements, making the final sample of 2,357 individuals.

Demographic and social characteristics

Information on age, completed years of school education, marital status, monthly family income, were collected through a structure interview.[19,20] For analysis, age was categorized into five 10-year age groups: 15 to 24; 25 to 34; 35 to 44; 45 to 54; and 55 to 64 years old. Education was categorized according to the number of completed schooling years as none; 1 to 4 years; 5 to 9 years; 10 years or more. Marital status was classified into three categories: Single, divorced, widower (living alone); Single (living with parents); Married (living with a companion). Monthly family income in kwanzas was converted into United States Dollars (USD) at the currency valid in 2014, and categorized into groups of no income; under or equal to 150 USD; 151 to 299 USD; and greater or equal to 300 USD. The area of residence was classified as rural or urban as previously described.[18]

Anthropometric measurements

Trained interviewers and certified health professionals conducted all anthropometric measurements as described before.[19] BMI was calculated as weight (kg) divided by squared height (m^2), and further categorized according to WHO as underweight (<18.5 kg/m^2), normal (18.5 to 24.99 kg/m^2), overweight (25.0 to 29.99 kg/m^2), and obese (≥30 kg/m^2).[3]

Statistical Analysis

Data were double entered into a PostgreSQL® database and imported into SPSS® version 23 (IBM, New York, USA) for statistical analysis. Post-stratification survey weights were calculated using the known sex and categorical age distribution of the Dande-HDSS population,[19] and these were used in all further calculations. Descriptive data are reported as absolute frequencies and percentages, and means and standard deviations when appropriate. Pearson's chi-square test or Fisher's exact test were used to assess the independence of BMI categories and socio-demographic characteristics, with a significance level of $p<0.05$. Prevalence estimates with a 95% confidence interval (95% CI) were computed for BMI categories by socio-demographic characteristics.

Ethics

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Ethics Committee of the Angolan Ministry of Health. Written informed consent was obtained from all subjects/patients (in the case of under 18 years old, their parent or legal guardian).

Results

The study population had a mean age of 32.5 (±13.6) years, with women (34.4±13.7 years) older than men (30.5±13.2 years) with 9.2% being older than 54 years. Approximately one-fifth of the population lived in rural areas and 16.6% of women and 1.4% of men had no formal education, with 51.1% of women having 4 or fewer years of formal education compared to 12.3% of men. The majority of the population (54.5%) reported living accompanied, women living alone (15.9%) more frequently them men (8.6%). Only 14.7% of the population had a monthly family income equal or superior to 300 USD, 56.4% presenting an income inferior to 150 USD, lower for women (Table 1).

The mean BMI was 23.5 (±4.9) Kg/m2 in women and 21.8 (±3.4) Kg/m2 in men. The overall prevalence of obesity was 6.8%, significantly higher in women (10.5%) than in men (2.8%). The proportion of overweight and obesity was 31.1% (95% CI 28.6, 33.8) in females and 13.5% (95% CI 11.6, 15.6) in males, with the gender prevalence of underweight being similar, 10.2% for females and 12.4% for males (Table 1).

The prevalence of overweight and obesity increased with age, obesity peaking in the age group 35 to 44 years, with 19.7% in females and 7.3% in males; underweight was more prevalent in the age group 15 to 24 years, 18.5% in females and 18.4% in males. Obesity prevalence has higher in urban areas, in both sexes (Table 2).

The prevalence of overweight and obesity decreased with education in women but increased in men. The lowest frequency of overweight and obesity are found among the individuals living with parents, in both sexes. Prevalence of overweight and obesity tended to be highest among participants with a monthly income above 150 USD in both sexes, with underweight higher in females (11.7%) with no income (Table 2).

Discussion

Nationally representative studies of obesity in sub-Saharan Africa are scarce. The studies that are available, though, suggest that obesity rates vary widely from country to country,

lacking strong evidence to support further comparisons and an adequate picture of the region, and a first local approach is needed to better design future interventions.

The 6.8% obesity prevalence encounter is lower than the 8.8% estimation made by NCD-RisC for 2014,[6] but similarly higher in females. This lower value that of the national estimates, possibly is due to the fact that the survey region is a tampon to Luanda, the capital of Angola, where people from the inner regions of the country, with less westernization of life patterns, tend to live and where the recent economic growth is not yet felt.

However, the mean BMI found is similar to the mean BMI calculated for the Africa Region in 2008 (23.9 Kg/m^2 in women and 21.8 Kg/m^2 in men),[5] and the pooled prevalence of overweight and obesity in the SSA region of 22.2% estimated in 2010,[4] being 22.7% (95% CI 21.0, 24.4) in our study.

In all reviews and WHO appraisals for African regional trends obesity is rising in the last decades according to the stages of nutrition transition.[6,8,11,13] If this tendency confirms also for the Dande-HDSS population, in the next decade the prevalence of overweight and obesity will increase, raising the concern for action related with NCD and associated risk factors.

The Dande-HDSS was developed as a district-level surveillance system in an urban and rural setting and is not representative of the demographic structure of Angola, but the findings, though not immediately generalizable, reveal the coexistence of similar levels of underweight and obesity, especially in urban areas and among females, common in the region,[13,21] as shown in studies conducted in South Africa,[22] Ghana,[23] and Nigeria.[24]

The prevalence of overweight and obesity is higher in women in all regions of the world.[2,5,10,12] In SSA countries, like Angola, an increased level of body fat is associated with prosperity and health, and the ideals of feminine beauty includes chubbiness.[25] Being slim, in contrast, is perceived to be a sign of illness or poverty and is something to be feared and avoided, particularly in recent years, when it has been associated with AIDS.[12,26] This cultural factor that enhances the probability of obesity in SSA women and other known associations of obesity with the urbanization process, socioeconomic status, and education,[5,9-14] puts the female gender more expose to this risk factor.

Education and monthly income are essential socio-demographic determinants to consider.[10,11,21-24,25] We found a higher prevalence of overweight and obesity among subjects

with higher income regardless of gender but only women with a lower level of education presented a higher prevalence of overweight and obesity. Higher incomes tend to be associated with differentiated professions, more sedentary, and to allow access to a more rich diet. If you associated the lower level of education of women (traditionally with domestic occupations) and the lack of knowledge to make the healthier choices (usually the family planner of meals), these factors can explain the results encountered. This is also compatible with other studies results, where living with a companion is associated with higher body weight.[27]

BMI is an indicator of multifactorial exposures, mainly behavioral and environmental in nature, such as caloric intake and physical activity, with individual genetic profile also having a role.[28] A closer surveillance of populations is needed, to detect changes in the so-called cause of the causes or interactions between this factors. This study provides a much-needed baseline for the evaluation of trends and interventions in Angola, even if of a more local framework. The frequency of NCD is expected to increase but data is still lacking and there must be a specific effort to accommodate a new reality to a health system mainly prepared to deal with the burden of infectious diseases, even at the level of information processes.

The training of human resources and the aim of the policies shall reflect this changes,[13] and incorporate appropriate responses to approach therapeutic and preventive health care, taking advantage of infectious diseases programs already in place,[29] and prioritizing the global obesity epidemic, one of seven risk factor targeted by the WHO “Global Action Plan for the Prevention and Control of NCDs, 2013/2020”.[30]

Conclusion

Obesity and underweight have a similar impact in this population describing an early stage of nutrition transition. Prevalence of overweight and obesity was higher in urban areas, among older individuals with a larger income, in both genders, and amongst more educated males. Female lower education and income compared with male, increases the need for dedicated health promotion programs that tackle the gender issue. Together with the double burden of communicable and NCD, this fight becomes more relevant in women if we consider that in the majority of the families they are the daily diet planners.

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Contributions

JMP participated in the study design, field activities, analysis of data, and drafted the paper. MB and HB participated in the study design and analysis, coordinated its implementation and revised subsequent drafts of the manuscript. All authors read and approved the final manuscript.

Conflict of Interest

The authors declare that there are no competing interests financial or nonfinancial. The interpretation of data and presentation of information is not influenced by any personal or financial relationship with any individual or organization. JMP is a staff member of the Calouste Gulbenkian Foundation, a Portuguese philanthropic organization. The author alone is responsible for the views expressed in this publication and they do not necessarily represent the decisions, policy, or views of the Calouste Gulbenkian Foundation.

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Table 1. Socio-demographic characteristics and Body Mass Index Categories by sex.

	Total (*n* = 2,357) % (95% CI)*	Female (*n* = 1,225) % (95% CI)*	Male (*n* = 1,132) % (95% CI)*	P-Value
Age				
15-24 years	36.2 (34.3-38.1)	30.1 (27.6-32.7)	42.7 (39.9-45.6)	
25-34 years	25.9 (24.2-27.7)	25.4 (23.0-27.9)	26.5 (24.0-29.1)	
35-44 years	16.1 (14.7-17.6)	18.7 (16.6-20.9)	13.3 (11.5-15.4)	<0.001
45-54 years	12.6 (11.3-14.0)	15.3 (13.4-17.4)	9.7 (8.1-11.6)	
55-64 years	9.2 (8.1-10.4)	10.6 (9.0-12.4)	7.8 (6.3-9.5)	
Place of residence				
Urban	81.0 (79.4-82.5)	81.2 (78.9-83.3)	80.8 (78.4-83.0)	0.838
Rural	19.0 (17.5-20.6)	18.8 (16.7-21.1)	19.2 (17.0-21.6)	
Education (*n* = 2,351)				
none	9.3 (8.2-10.5)	16.6 (14.6-18.8)	1.4 (0.9-2.3)	
1-4 years	23.1 (21.5-24.9)	34.5 (31.9-37.2)	10.9 (9.2-12.8)	<0.001
5-9 years	42.2 (40.2-44.2)	35.7 (33.1-38.5)	49.2 (46.3-52.1)	
>10 years	25.4 (23.7-27.2)	13.1 (11.4-15.2)	38.5 (35.7-41.4)	
Marital Status (*n* = 2,332)				
Single, divorce, widower (living alone)	12.4 (11.1-13.8)	15.9 (13.9-18.0)	8.6 (7.1-10.4)	
Single (living with parents)	33.1 (31.2-35.0)	25.1 (22.8-27.7)	41.7 (38.8-44.6)	<0.001
Married (living with companion)	54.5 (52.5-56.5)	59.0 (56.2-61.7)	49.7 (46.8-52.6)	
Montly Family Income (*n* = 1,345)				
No income	8.4 (7.0-10.0)	10.9 (8.8-13.3)	5.3 (3.8-7.3)	
≤150 USD	48.0 (45.3-50.6)	54.8 (51.2-58.4)	39.6 (35.8-43.6)	<0.001
151-299 USD	29.0 (26.6-31.5)	28.0 (24.8-31.3)	30.3 (26.7-34.0)	
≥300 USD	14.7 (12.9-16.7)	6.4 (4.8-8.4)	24.7 (21.4-28.2)	
Body Mass Index Categories (kg/m^2)				
Underweight (<18.5)	11.3 (10.1-12.6)	10.2 (8.6-12.0)	12.4 (10.6-14.5)	
Normal (18.5-24.99)	66.1 (64.1-67.9)	58.6 (55.8-61.4)	74.1 (71.4-76.5)	<0.001
Overweight (25.0-29.99)	15.8 (14.4-17.4)	20.6 (18.4-23.0)	10.7 (9.0-12.6)	
Obese (≥30)	6.8 (5.9-7.9)	10.5 (8.9-12.4)	2.8 (2.0-4.0)	

* post-stratification weights used as described in the methods section.

Table 2. Body Mass Index categories by sex and socio-demographic caracteristics.

	Women % (95% CI)*					Men % (95% CI)*				
	Underweight	Normal	Overweight	Obese	P-Value	Underweight	Normal	Overweight	Obese	P-Value
Age										
15-24 years	18.5 (14.8-22.8)	68.8 (63.8-73.3)	9.8 (7.2-13.2)	3.0 (1.7-5.3)		18.4 (15.2-22.0)	77.3 (73.4-80.8)	3.5 (2.2-5.5)	0.8 (0.3-2.1)	
25-34 years	5.8 (3.7-9.0)	58.8 (53.3-64.2)	24.4 (20.0-29.5)	10.9 (7.9-14.9)		5.3 (3.3-8.5)	79.7 (74.8-83.8)	12.7 (9.4-16.9)	2.3 (1.1-4.7)	
35-44 years	6.1 (3.7-10.0)	48.0 (41.6-54.5)	26.2 (20.9-32.3)	19.7 (15.0-25.3)	<0.001	9.9 (6.1-15.7)	62.3 (54.3-69.6)	20.5 (14.9-27.7)	7.3 (4.1-12.6)	<0.001
45-54 years	7.4 (4.5-12.1)	56.4 (49.2-63.3)	22.3 (17.0-28.8)	13.8 (9.6-19.5)		11.0 (6.4-18.3)	64.2 (54.9-72.6)	20.2 (13.7-28.7)	4.6 (2.0-10.3)	
55-64 years	9.3 (5.4-15.6)	51.2 (42.6-59.6)	29.5 (22.3-37.8)	10.1 (6.0-16.5)		10.3 (5.5-18.5)	70.1 (59.8-78.7)	13.8 (8.1-22.6)	5.7 (2.5-12.8)	
Place of residence										
Urban	10.1 (8.3-12.1)	58.2 (55.1-61.2)	20.2 (17.9-22.9)	11.5 (9.6-13.6)	0.184	13.4 (11.4-15.8)	72.2 (69.2-75.0)	11.1 (9.2-13.3)	3.3 (2.3-4.6)	0.011
Rural	10.9 (7.5-15.6)	60.7 (54.2-66.8)	21.8 (17.0-27.6)	6.6 (4.0-10.5)		7.9 (5.0-12.2)	82.4 (76.8-86.9)	8.8 (5.7-13.3)	0.9 (0.3-3.3)	
Education										
none	8.4 (5.3-13.0)	57.6 (50.8-64.2)	22.7 (17.4-28.9)	11.3 (7.7-16.4)		20.0 (7.0-45.2)	80.0 (54.8-93.0)	-[a]	-[a]	
1-4 years	6.4 (4.5-9.2)	53.1 (48.3-57.8)	25.2 (21.3-29.6)	15.2 (12.1-19.0)	<0.001	12.1 (7.5-19.0)	75.0 (66.7-81.8)	12.1 (7.5-19.0)	0.8 (0.1-4.4)	<0.001[b]
5-9 years	13.6 (10.7-17.1)	61.8 (57.2-66.3)	17.0 (13.8-20.8)	7.6 (5.5-10.5)		16.3 (13.5-19.6)	71.2 (67.3-74.8)	10.0 (7.8-12.8)	2.5 (1.5-4.2)	
>10 years	13.8 (9.3-19.9)	65.0 (57.3-72.0)	15.6 (10.8-22.0)	5.6 (3.0-10.3)		7.1 (5.1-9.9)	77.5 (73.3-81.1)	11.5 (8.8-14.8)	3.9 (2.5-6.2)	
Marital Status										
Single, divorce, widower (living alone)	9.4 (6.0-14.3)	54.7 (47.6-61.6)	24.0 (18.5-30.5)	12.0 (8.1-17.3)		10.3 (5.7-17.9)	76.3 (66.9-83.6)	10.3 (5.7-17.9)	3.1 (1.1-8.7)	
Single (living with parents)	20.4 (16.2-25.3)	68.1 (62.7-73.1)	8.6 (5.9-12.2)	3.0 (1.6-5.5)	<0.001	18.8 (15.5-22.6)	76.3 (72.2-79.9)	3.6 (2.3-5.7)	1.3 (0.6-2.8)	<0.001
Married (living with companion)	6.0 (4.5-8.0)	55.7 (52.0-59.3)	25.0 (21.9-28.3)	13.3 (11.0-16.0)		7.4 (5.5-9.8)	72.4 (68.5-75.9)	16.0 (13.2-19.3)	4.3 (2.9-6.3)	
Montly Family Income										
No income	11.7 (6.3-20.7)	59.7 (48.6-70.0)	24.7 (16.4-35.4)	3.9 (1.3-10.8)		3.6 (0.6-17.7)	71.4 (52.9-84.7)	17.9 (7.9-35.6)	7.1 (2.0-22.6)	
≤150 USD	7.2 (5.0-10.3)	60.3 (55.3-65.2)	23.1 (19.1-27.6)	9.4 (6.8-12.8)	0.001	10.1 (6.8-14.7)	76.3 (70.4-81.4)	11.8 (8.3-16.7)	1.8 (0.7-4.4)	0.021
151-299 USD	3.6 (1.7-7.2)	52.3 (45.3-59.2)	27.2 (21.4-33.8)	16.9 (12.3-22.8)		4.6 (2.3-8.8)	74.9 (67.9-80.7)	16.6 (11.8-22.8)	4.0 (2.0-8.0)	
≥300 USD	2.2 (0.4-11.6)	46.7 (32.9-60.9)	26.7 (16.0-41.0)	24.4 (14.2-38.7)		5.6 (2.9-10.7)	66.9 (58.8-74.1)	19.0 (13.4-26.3)	8.5 (4.9-14.2)	

* Post-stratification weights used as described in the methods section.
[a] No individuals in this category
[b] Fisher's Exact Test

4.5. Paper VI - Cardiovascular risk prediction

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Cardiovascular risk assessment in Angolan adults: a descriptive analysis from CardioBengo, a community-based survey

International Journal of Hypertension [Submitted]

Abstract

From a community-based survey conducted in Angola, 468 individuals aged 40 to 64 years and not using drug therapy, were evaluated according to the World Health Organisation STEPwise Approach to Chronic Disease Risk Factor Surveillance. Using data from tobacco use, blood pressure, blood glucose and total cholesterol levels, we estimated the 10-year risk of a fatal or nonfatal major cardiovascular event and computed the proportion of untreated participants eligible for pharmacological treatment according to clinical values alone and total cardiovascular risk. The large majority of participants were classified as having a low (<10%) 10-year cardiovascular risk (87.6%), with only 4.5% having a high (≥ 20%) cardiovascular risk. If we consider the single criteria for hypertension, 48.7% of the population should be considered for treatment. This value decreases to 22.0% if we apply the risk prediction chart. The use of hypoglycaemic drugs does not present any differences (19.0% in both situations). The use of lipid-lowering drugs (3.8%) is only recommended by the risk prediction chart. This study reveals the need and urgency of pharmacological treatment for cardiovascular disorders in this population, integrated with non-pharmacological measures. Risk prediction charts can be used, which globally improves the efficacy of interventions and reduce costs.

Keywords: Angola, hypertension, diabetes, hypercholesterolemia, risk assessment.

Introduction

Cardiovascular diseases (CVD) caused 17.9 million deaths worldwide in 2015, a number that has increased globally by 12.5% since 2005, with almost 80% of these deaths occurring in low and middle-income countries [1]. Their common occurrence and associated mortality, loss of independence and productivity, impaired quality of life, and social and economic costs are compelling reasons for public health concern globally [2].

The epidemiology of CVD is distinctly different in sub-Saharan Africa (SSA), compared to the rest of the world, where an unprecedented decline in mortality and a corresponding increase in the life expectancy at birth are shifting the epidemiological landscape of the region [3]. Countries in this region, where Angola is located, face a double burden as they struggle to cope with non-communicable and infectious diseases associated with lack of socio-economic development [3].

In 1990 the percentage of deaths by CVD in the region was 7.5% (the fourth cause of death), rising to 11.2% in 2015, being the third cause of mortality [4]. Myocardial infarctions, together with strokes, were responsible for 10.8% of deaths among females and 8.6% in males, in 2015 in SSA [4]. This represents an increase in mortality of 38.0% for stroke and 52.1% for myocardial infarction in both sexes, since 1990 [4], revealing a rising trend of CVD in SSA. The estimates made for Angola follow the same pattern, with strokes being responsible for 5.4% and myocardial infarction for 4.7% of all deaths, in 2015 - the fourth and sixth cause of mortality in Angola, respectively [4].

Risk factors for CVD are shared with the majority of non-communicable diseases and are due to exposure to behavioural risk factors: tobacco and alcohol consumption, unhealthy diet, and physical inactivity; individually modifiable. These unhealthy behaviours influence metabolic pathways and ultimately result in intermediate risk factors: obesity, hypertension, diabetes and dyslipidaemia [5-7].

Common approaches that address behavioural and metabolic risk factors, which often coexist in the same person and act synergistically to increase an individual's total risk, are proven effective for prevention [6,7], but in some settings, the risk factors are tackled one-by-one, without a common strategy. To design the right strategy for an individual, it is important to realise his/her 'global risk' of developing CVD [7-9]. The World Health Organization (WHO) and the International Society of Hypertension (ISH) created a risk prediction chart [8], which can be applied in different populations.

In this short report, we aimed to quantify the proportion of individuals eligible for pharmacological treatment for hypertension, diabetes and hypercholesterolemia according to single risk factor and total cardiovascular risk approaches, according to the WHO-ISH risk prediction chart.

Materials and Methods

The present analysis results from CardioBengo, a community-based study conducted in the catchment area of the Dande - Health Demographic Surveillance System (Dande-HDSS), located in the Dande Municipality, in Bengo Province, Angola [10]. This survey, done between September 2013 and March 2014, constitutes a larger baseline on cardiovascular risk factors [11], being based on the WHO STEPwise approach to Surveillance (STEPS) to Chronic Disease Risk Factor manual (core and expanded version 3.0) [12].

Sample characterization

A representative sex- and age-stratified random sample list was drawn from the Dande-HDSS population database (15 to 64 years old) and a total of 2,484 individuals were included in the CardioBengo study [11,13].

Based on the WHO-ISH risk prediction chart criteria of application [8], only individuals aged 40 or older were considered for analysis. From the initial 688 participants aged 40–64 years, 123 were excluded because of missing information in any of the parameters, and another 97 excluded because they were receiving pharmacological treatment for any of the three conditions. The final sample consists of 468 participants, not significantly different from the initial 688 participants considered for analysis regarding place of residence, sex, age, or education.

Data collection

Participants were evaluated by trained interviewers and certified health professionals. As previously described in the CardioBengo study protocol [11], information on age and tobacco consumption were collected through an interview, and blood pressure and all clinical measurements (measured only in participants with overnight fasting) were obtained with the use of point of care devices, namely: automatic sphygmomanometer OMRON M6 Comfort (OMRON Healthcare Europe BV, Hoofddorp, The Netherlands); blood glucose meter ACCU-CHEK Aviva (Roche Diagnostic, Indianapolis, USA); and ACCUTREND Plus (Roche Diagnostic, Indianapolis, USA) with ACCUTREND CHOLESTEROL reactive strips (Roche Diagnostic, Indianapolis, USA) [11].

Prediction methods and eligibility for pharmacological treatment

The WHO-ISH prediction chart for the Africa D region was used to classify each participant regarding the individual absolute cardiovascular risk [8], based on sex (male or female), age (40–49, 50–59 and ≥ 60 years), current smoking status (non-smoker or smoker), systolic blood pressure (SBP) (120-139, 140–159, 160–179, and ≥ 180 mmHg), total blood cholesterol (4, 5, 6, 7 and 8 mmol/l) and diabetes (presence or absence, considering the WHO cut point of 6.9 mmol/l [14]).

The WHO-ISH prediction charts estimate the 10-year risk of a fatal or nonfatal major cardiovascular event (myocardial infarction or stroke) expressed in five categories - ≤10% (low), 10–19% (moderate), 20–29% (high), and ≥30% (very high) - in people who do not have established cardiovascular diseases [8].

The eligibility for treatment with antihypertensive, hypoglycaemic or lipid-lowering drugs was defined according to the WHO guidelines for assessment and management of cardiovascular risk [8]. Also, eligibility for treatment according to the single risk factor approach was considered: for antihypertensive drug use SBP of ≥140 mmHg [15]; for hypoglycaemic drug use fasting blood glucose >6.9 mmol/l [14]; and for lipid-lowering drugs use a total blood cholesterol level ≥8 mmol/l [9].

Statistical Analysis

Data were double entered into a PostgreSQL® database and imported into SPSS® version 23 (IBM, New York, USA) for data analysis. Descriptive data are reported as absolute frequencies and percentages. We estimated the proportion of participants classified in different categories of total cardiovascular risk, as well as the proportion of subjects eligible for pharmacological treatment (according to the different criteria), by sex. We consider a 95% confidence interval (95% CI) for all proportions calculated.

Ethical approval

All procedures performed in this study were in accordance with the standards of the Ethics Committee of the Angolan Ministry of Health, and with the 1964 Helsinki declaration and its later amendments. Written informed consent was obtained from all participants.

Results

The majority of the population in this study was female (69.7%) following the structure of the Dande-HDSS [10], with 17.9% of the population aged above 60 years. Smoking was more

frequent among men (18.3% versus 7.4% in women) with almost half the population (48.7%) presenting a SBP ≥140 mmHg, with a higher occurrence in women (52.5% versus 40.1% in men). None of the individuals presented total blood cholesterol >8 mmol/l, with only women presenting values >7 mmol/l (6.1%). The prevalence of diabetes was similar among men and women (18.4% in women and 20.4% in men), with almost 10% of the population having both SBP ≥140 mmHg and diabetes (table 1).

Table 1. Characteristics of the participants and prevalences by sex.

	Total (*n* = 468) % (95% CI)	**Female (*n* = 326) % (95% CI)**	**Male (*n* = 142) % (95% CI)**
Age (years)			
40-49	36.3 (32.1-40.8)	35.0 (30.0-40.3)	39.4 (31.7-47.6)
50-59	45.7 (41.2-50.2)	47.9 (42.5-53.3)	40.8 (33.1-49.0)
≥ 60	17.9 (14.7-21.6)	17.2 (13.5-21.7)	19.7 (14.0-27.0)
Current smoking status			
Non-smoker	89.3 (86.2-91.8)	92.6 (89.2-95.0)	81.7 (74.5-87.2)
Smoker	10.7 (8.2-13.8)	7.4 (5.0-10.8)	18.3 (12.8-25.5)
Systolic blood pressure (mmHg)			
120-139	51.3 (46.8-55.8)	47.5 (42.1-52.9)	59.9 (51.7-67.6)
140-159	26.7 (22.9-30.9)	26.7 (22.2-31.8)	26.8 (20.2-34.6)
160-179	14.3 (11.4-17.8)	16.6 (13.0-21.0)	9.2 (5.5-15.1)
≥ 180	7.7 (5.6-10.4)	9.2 (6.5-12.8)	4.2 (1.9-8.9)
Total blood cholesterol (mmol/l)			
4	55.6 (51.1-60.0)	52.1 (46.7-57.5)	63.4 (55.2-70.9)
5	27.1 (23.3-31.3)	26.7 (22.2-31.8)	28.2 (21.4-36.1)
6	13.0 (10.3-16.4)	15.0 (11.5-19.3)	8.5 (4.9-14.2)
7	4.3 (2.8-2.8)	6.1 (4.0-9.2)	0
8	0	0	0
Diabetes[a]			
Absence	81.0 (77.2-84.3)	81.6 (77.0-85.4)	79.6 (72.2-85.4)
Presence	19.0 (15.7-22.8)	18.4 (14.6-23.0)	20.4 (14.6-27.8)
With SBP >140 mmHg and Diabetes	9.8 (7.4-12.8)	9.5 (6.8-13.2)	10.6 (6.5-16.7)

[a] Fasting blood glucose ≥6.9 mmol/l

Most of the participants (87.6%) were classified as having low (<10%) 10-year cardiovascular risk. The frequencies were 7.9%, 2.6% and 1.9% for the cardiovascular risk category 10–19 (moderate), 20–29 (high) and ≥30% (very high), respectively. Women presented higher frequencies than men in all cardiovascular risk categories above the moderate level and the total cardiovascular risk increased with age (table 2).

Table 2. Distribution of 10-year risk of a fatal or nonfatal major cardiovascular event, acording to sex and age.

	Total, % (95% CI)			
	≤10% **Low**	**10-19%** **Moderate**	**20-29 %** **High**	**≥30%** **Very High**
40-49 years	34.2 (30.0-38.6)	1.3 (0.6-2.8)	0.6 (0.2-1.9)	0.2 (0.0-1.2)
50-59 years	40.6 (36.2-45.1)	3.6 (2.3-5.7)	0.6 (0.2-1.9)	0.9 (0.3-2.2)
≥ 60 years	12.8 (10.1-16.2)	3.0 (1.8-5.0)	1.3 (0.6-2.8)	0.9 (0.3-2.2)
Total	**87.6 (84.3-90.3)**	**7.9 (5.8-10.7)**	**2.6 (1.5-4.4)**	**1.9 (1.0-3.6)**
	Female, % (95% CI)			
	≤10% **Low**	**10-19%** **Moderate**	**20-29 %** **High**	**≥30%** **Very High**
40-49 years	32.5 (27.7-37.8)	1.5 (0.7-3.5)	0.6 (0.2-2.2)	0.3 (0.1-1.7)
50-59 years	41.7 (36.5-47.1)	4.0 (2.3-6.7)	0.9 (0.3-2.7)	1.2 (0.5-3.1)
≥ 60 years	11.7 (8.6-15.6)	3.1 (1.7-5.6)	1.8 (0.8-4.0)	0.6 (0.2-2.2)
Total	**85.9 (81.7-89.3)**	**8.6 (6.0-12.1)**	**3.4 (1.9-5.9)**	**2.1 (1.0-4.4)**
	Male, % (95% CI)			
	≤10% **Low**	**10-19%** **Moderate**	**20-29 %** **High**	**≥30%** **Very High**
40-49 years	38.0 (30.5-46.2)	0.7 (0.1-3.9)	0.7 (0.1-3.9)	-[a]
50-59 years	38.0 (30.5-46.2)	2.8 (1.1-7.0)	-[a]	-[a]
≥ 60 years	15.5 (10.5-22.3)	2.8 (1.1-7.0)	-[a]	1.4 (0.4-5.0)
Total	**91.5 (85.8-95.1)**	**6.3 (3.4-11.6)**	**0.7 (0.1-3.9)**	**1.4 (0.4-5.0)**

[a] No individuals in this category

Considering only the criteria of SBP ≥140 mmHg, 48.7% of the population should be considered for treatment with antihypertensive drugs, but if we apply the WHO/ISH criteria based on the prediction chart, this number will decrease by more them half to 22.0%. On the other hand, the use of lipid-lowering drugs is not considered for any individual by the singular criteria, but if we apply the prediction chart, this number rises to 3.8% (table 3).

Table 3. Frequencies of individuals who require pharmacological treatment by sex.

	Single risk criteria			Considering WHO/ISH[a] risk prediction		
	Total, % (95% CI)	**Female, % (95% CI)**	**Male, % (95% CI)**	**Total, % (95% CI)**	**Female, % (95% CI)**	**Male, % (95% CI)**
Antihypertensive drugs	48.7 (44.2-53.2)	52.5 (47.0-57.8)	40.1 (32.4-48.4)	22.0 (18.5-26.0)	25.8 (21.3-30.8)	13.4 (8.7-20.0)
Lipid-lowering drugs	-[b]	-[b]	-[b]	3.8 (2.4-6.0)	4.9 (3.0-7.8)	1.4 (0.4-5.0)
Hypoglycaemic drugs	19.0 (15.7-22.8)	18.4 (14.6-23.0)	20.4 (14.6-27.8)	19.0 (15.7-22.8)	18.4 (14.6-23.0)	20.4 (14.6-27.8)

[a] World Health Organization/International Society of Hypertension

[b] No individuals in this category

Discussion

Only 4.5% of the population was classified as having at least a high (≥20%) cardiovascular risk. These results are in accordance with those described in other populations of the continental sub-Saharan Africa, namely 3.7% in Mozambique [16] and 5% in Nigeria [17], or in other low and middle-income countries in Asia (4.9% in rural India, 1.3% in Cambodia, 2.3% in Malaysia and 6% in Mongolia) [18,19].

In all these surveys, the accumulation of risk factors exists in different levels. In our population, almost one tenth accumulated at least two major risk factors (hypertension and diabetes). This raises additional concerns when we compare these results with the awareness levels for the conditions studied in our population - 48.5% among hypertensive individuals, 10.8% for diabetes and 4.2% for hypercholesterolemia (13).

Even with the need to interpret cautiously the results - because they are based in a survey with only one time measure of blood pressure, blood glucose and lipids, and there is a chance that individuals enrolled did not report correctly the fasting period before the readings – this survey disclose an emerging public health issue and provides additional information on the impact of the use of risk prediction charts.

According to the WHO guidelines for assessment and management of cardiovascular diseases [8], at least one quarter of the participants would be eligible for treatment with antihypertensive drugs, whereas if only the single criteria were applied for hypertension, almost half would be considered for pharmacological treatment.

The use of the WHO-ISH risk prediction chart has already been proven as more cost effective than other approaches that make treatment decisions based on individual risk-factor thresholds only, especially for hypertension management [7,20-22]. In a South-African study, different strategies for initiation of drug treatment were tested, and the conclusion points to the fact that hypertension treatment based on the total cardiovascular risk is more effective at saving lives and less costly than those based only on the BP level [23].

In this prediction chart, we included the total cholesterol measurement, however, the WHO-ISH chart offers the possibility of not using this measurement [8]. The use of laboratory (or point of care) assessment in low-resource settings is dispensable, avoiding additional costs to the system without losing a significant predictive power or introducing an overconsumption of drugs, allowing for a better targeting of resources to those who are more likely to develop CVD [24,25].

The high percentage of individuals that requires pharmacological treatment for diabetes (19.0%, very similar between gender) is alarming, considering that diabetes alone is a very important health condition, but also an important risk factor for CVD - adults with diabetes have a two or three times higher rate of CVD than adults without diabetes [8,26].

Health promotion initiatives such as smoking cessation, and individual advisement on specific lifestyle and diet control are also strategies necessary to align with the use of pharmacological treatments. Even if some of the proposed methodologies (statins for hypercholesterolemia, for example) cannot be easily applied due to the steady supply of drugs, changes to personal lifestyle should be encouraged, with good results in the decrease of the global cardiovascular risk [17,20,21].

The focus of targeting high-risk people through a total cardiovascular risk approach instead of a single risk factor approach reduces health care expenditure by reducing drug costs [17]. However, to diminish CVD burden in the entire population in a sustainable way, wider interventions are needed. The focus should be on the primary healthcare, where the majority of the individuals have access, allowing for the promotion of opportunistic screening of CVD risk factors and patient registration and tracking, with a better use of available resources [22].

Conclusion

The use of the WHO-ISH guidelines for cardiovascular risk prediction reduces to half the population eligible for pharmacological treatment with antihypertensive drugs. Taking into

account the evidence on positive effects of different approaches to manage risk factors at a population level, the substantial differences in the number of individuals eligible for treatment according to the distinct criteria suggests that considering the total cardiovascular risk may allow a more wise use of resources available.

Data Availability

The data used to support the findings of this study were provided by Dande-HDSS Data Base under license, and so cannot be made freely available. Access to these data will be considered upon request, with permission of the Dande-HDSS administrator. Inquiries can me made to info@cisacaxito.org.

Conflicts of Interest

The authors declare that there are no competing interests financial or nonfinancial with regards to this study. The interpretation of data and presentation of information is not influenced by any personal or financial relationship with any individual or organization. JMP is a staff member of the Calouste Gulbenkian Foundation, a Portuguese philanthropic organization. The author alone is responsible for the views expressed in this publication and they do not necessarily represent the decisions, policy, or views of the Calouste Gulbenkian Foundation.

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5. General discussion

Angola is located in Central Africa (WHO region D) and classified by the World Bank as upper-middle-income country.[111] However, this classification does not reflect the Human Development Index (HDI), which categorises Angola in the low human development group (rank 149 of a total 188 countries), and the inequality-adjusted HDI reduces this ranking by eight places.[112]

After an aggregated period of 40 years of colonial (from 1961 to 1974) and civil war (from 1975 to 2002), Angola started to develop its extracting industry (mainly crude oil), allowing the country to become one of the emerging economies of the 21st century that have suffered a significant blow in the recent global economic crisis.[111]

Like many other transitional economies, Angola is undergoing a rapid demographic transition characterised by an increase in longevity that will alter the age-sex structure of the population.[106] The life expectancy at birth is expected to rise from the actual 61 years to 69 years between 2015 and 2050, together with a reduction in fertility from 5.5 new-borns per woman in 2015 to 3.2 in 2050.[106]

With the economic growth and recent crisis, and considering the age-sex structural transition, a rising trend in the CVD burden is expected, putting the country in an epidemiological and nutritional transition period. During this time, CVDs and other NCDs will co-exist with infectious diseases and maternal and child deaths (one of the highest in the world),[2,112] in a setting barely prepared to deal with the existing health problems. As already mentioned, data on gender-, poverty- and health-related issues lack in the country.[112]

With this national social pattern as its background, this thesis elaborated on the epidemiology of CVD risks factors in an adult population from the Dande-HDSS. Without attempting to make general predictions at a national level, the similarities between the studied population and the national demographic structure were discussed in Section 3.1, allowing us to consider the results extracted from this survey as a good predictor of and strong evidence for future planning of health policies for CVDs in Angola.

As a first result, we must point to the immediate effect on the health structures of the region. The implementation of an epidemiological survey with this magnitude (nearly 10% of all adults between the ages of 15 and 64 years were enrolled in the study) created a larger occurrence of hypertension and diabetes cases for the Bengo General Hospital. As a

response, and integrated into the extensive protocol CardioBengo, a new service dedicated to cardiovascular and metabolic disorders was created to respond to the nearly 10 new cases detected each day.

CardioBengo, more than a single community-based survey, launched the foundation to further prospective studies, in particular among the younger age groups in this survey, to allow CVD research to become a reality in Angola. This thesis only analysed part of the data; other Angolan researchers are developing research work, especially in population genetics background and clinical outcomes. A large dataset is yet to be explored, and diet and physical activity variables need to be fine-tuned and related with other risk factors. Regarding the results shared in this thesis, an integrated discussion of the epidemiological observation is suggested in the next paragraphs.

As expected, all risk factors were more frequent in older ages.[2,22,23] However, the concept of older ages in this population must be reconsidered. Only 3.6% of this population was above 65 years[104,105] and were not represented in this study. The outcomes of CVD in developing countries (like Angola) occur 10 to 15 years earlier than in developed countries,[25] and older ages with the higher prevalence of risk factors in the studied population were between 45 to 54 years and 55 to 64 years, in both sexes.

The differences between genders were clear in this survey, putting the female gender at the top of risk factor prevalence. In addition to the natural causes related to ageing (women live longer than men),[27] and hormone regulation post-menopause,[26] women accumulate other social disadvantages, like less education and income. Also, the cultural aspects of African societies that encourage overweight among females[113] create additional pressure in this group. The only risk factor that was lower in females was smoking, which is culturally accepted among men but not for women.

Urbanisation is taking its toll, with a higher prevalence of diabetes, hypercholesterolaemia and obesity in urban areas for this population. These risk factors are related to unhealthy diets and physical inactivity, common among urban dwellers.[11,86,87] However, a better clarification of urban and rural areas for this region is needed. The concept of peri-urban areas (dispersive urban growth) possibly applies to the Dande-HDSS area due to the proximity to Luanda, the capital of Angola, and the migration patterns between these regions, making the influence of urbanisation in this population unclear.

Lower educational levels were associated with a higher prevalence of all behavioural risk factors for this population (except in men for obesity), following the pattern in high-income countries.[82] The relationship between education and obesity in developing societies tends to follow the opposite direction, with more educated individuals presenting a higher prevalence of obesity[84] due to a more sedentary life and “eating out”.

Family income was also analysed in this population for the first time, and additional improvements are needed to access the population’s income levels. A higher income was associated with a lower prevalence of smoking and a higher prevalence of obesity. A better definition of this variable in this context is already in place, interconnecting other economic aspects of the individual and household incomes.

Considering the standard of comparison among populations, which include only adults above the age of 25 years, almost a quarter of this population presents raised blood pressure, a high value, but aligned with the SSA region. Also, the cumulative incidence rate of 12.2% is higher than the majority of rates encountered in developed countries. Due to the novelty of this finding in SSA, comparing results to other regional studies is not possible.

Hypertension is the CVD risk factor better studied in Angola and in SSA, affecting both sexes in similar values (but in a heavier weight in females), individuals with lower educational levels and associated with urban areas. However, in our study, it was higher in rural dwellers, possibly related to the migration patterns of the region with individuals exposed to the urban environment.

The prevalence level of diabetes was aligned with the mean values encountered for SSA but was higher than the predictions and values from other studies conducted in Angola in the last 15 years. The importance of this risk factor alone and association with all other risk factors justifies further follow-up of the diabetic population not only for the management of the disease, but also for a better understanding of the disease evolution and relation to possible metabolic syndrome.

Hypercholesterolemia is the least studied metabolic risk factor in SSA, mainly due to the difficulties in implementing laboratory tests with confidence. We applied point of care technology with fair results limited to total blood cholesterol levels. The prevalence was relatively low, but association with other risk factors raises the total risk prediction for this population. Hypercholesterolemia is also a good predictor of the influence of unhealthy diets and sedentary life styles and should be further studied in this population.

The levels of awareness, treatment and control were low for hypertension. Because diabetes and hypercholesterolaemia were first studied in this population with the CardioBengo implementation, the levels of awareness, and consequently of treatment and control, were even lower. These values are aligned with the SSA region and highlight the increased urgency for intervention. This population was not previously targeted by any health program or initiative that promoted healthier lifestyles or provided diagnoses, but the few participants that were aware and under treatment for any of the conditions reported a health professional suggested non-pharmacological measures to prevent CVD.

Obesity presented similar prevalence values as underweight, revealing the nutritional transition that this population is facing. Women were more obese than men, like other studies for SSA reveal.[76,77] Obesity was associated with all the other risk factors, from hypertension to smoking, meaning that this risk factor is the primordial target for health promotion campaigns, but having in mind the limitation in food choices and cultural habits.

Smoking prevalence was not high when compare with values worldwide, but it was associated with alcohol consumption and was a risk factor present in the majority of individuals with other risk factors, especially hypertension. This prevalence value, and general low level of nicotine dependence, implies an urgent implementation of restrictive policies for tobacco, before this value rises.

Pharmacological treatment for some of these conditions can be a problem in terms of associated costs and availability of drugs. However, it must be consider, especially for individuals that already had clinical episodes of CVD or have long-term hypertension and/or diabetes. The use of guidelines for cardiovascular risk prediction is proven effective and efficient in the use of resources available in the region.[21,22,93] If treatment is well-integrated in a “holistic” approach, with non-pharmacological measures in place, the results can improve, both in the individual and in the general population.[21,93,94]

Having this knowledge for future local health policy planning is an advantage for public health practitioners; however, they should not plan alone. Politics, academia and international donor partners of the Angolan government must recognize that CVDs and associated risk factors already exist in the country, and if nothing is done, the costs of future interventions will rise and lose efficacy.[114]

The global health community is concern with CVDs and NCDs in general. The WHO, together with other multi-stakeholder organisations, is providing technical support and collecting evidence every day to find the “best buy” for NCD prevention, management and treatment. Most of this knowledge originates from high-income societies and is not adapted to the cultural and social pattern of a quick-shifting African society. [4,21,44,69,86,91,93,94,100]

Cardiovascular diseases and associated factors are becoming a public health problem, which carries economic implications created by premature mortality in an age group (40 to 60 years) relevant to society due to the investment in its educational level and leadership skills.[114,115] After the current phase of collecting this evidence, a new stage of implementation and interventional research is needed.[116]

The strategy should include the strengthening of primary care, taking advantage of the structures and programs created to deal with infectious diseases. In a continent where health professional training and healthcare systems are designed to prevent and manage endemic communicable diseases (e.g., malaria, tuberculosis and HIV/AIDS), these resources should be maximised and adapted to deal also with NCDs.[93,94,100]

Because of the limited resources and lack of infrastructure for the diagnosis and management of CVDs, possible strategies for strengthening health systems can focus on four major areas:[64]

1) Development of human resources,
2) Improvement in infrastructure for diagnosis and management of CVDs,
3) Implementation of basic registries for mapping of CVDs and risk factors,
4) Establishment of partnerships with stakeholders outside the health sector.

Some of these solutions are already in place, and only time and continuous research of CVDs and associated risk factors can provide results.[4,116]

6. Conclusion

We were able to create and implement a community-based study to research the epidemiology of CVD risk factors and associations between them in the adult population of the Bengo Province, in Angola. This survey can constitute the basis of a surveillance system for CVDs and NCDs in general for Angola, using a population that presents the same demographic structure of the country.

The cultural and social pattern of the population should be considered in the implementation of health promotion strategies. The translation of solutions from other regions or countries is not possible without the evaluation of the previous environment and interaction among risk factors.

The hypertension prevalence is high in this population, and we provide the first evidence that it is rising rapidly. Additionally, the current prevalence of diabetes is higher, with hypercholesterolaemia also existing. Diabetes and hypercholesterolaemia were higher among urban dwellers, where obesity was also higher. Urbanisation marks the rise of diet-associated risk factors, especially among women. The observed low levels of awareness, treatment and control of these three conditions indicate a high burden of undiagnosed and uncontrolled conditions, putting additional stress on the need for primary care intervention.

This Angolan population presents a low smoking prevalence, with a low number of daily smoked cigarettes and low levels of nicotine dependency, despite the low prices and easy access to manufactured cigarettes. The implementation of stronger interventions at the beginning of the expected rise in smoking prevalence may halt and reverse the tendency observed in the African region.

The prevalence of obesity was similar to the prevalence of underweight, reflecting a nutrition transition state. As in other African communities, women present a higher prevalence of overweight and obesity than men, but both genders have similar values of underweight. This stresses the need for special health promotion and interventions, designed to deal with the accumulation of risk factors for different disease groups in the female gender.

There is also an urgent need for pharmacological treatment of cardiovascular disorders, integrated with non-pharmacological measures, in this population. This can be created using risk prediction charts, which globally improve the efficacy of the interventions and reduce costs.

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Annexes

Annexe I

Questionnaire

Estudo dos fatores de risco cardiovasculares numa população adulta da Província do Bengo, Angola
Entrevista e dados clínicos

Data: |___|___|-|___|___|-|___|___|___|___| (Dia, Mês, Ano) **Hora de início:** |___|___| h |___|___| m

ID: |___| |___| |___|-|___| |___|-|___| |___| |___| |___| - |___| |___| |___| (Bairro, Sector, AF, ID)

Nome Completo: |___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|
|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___| Consentimento Informado Entregue → O

A. Dados sociodemográficos - com recurso a doc ID O (1) ou aproximação O **(2)** **(Posto #1)**

1. Data nascimento: |___|___|-|___|___|-|___|___|___|___| (Dia, Mês, Ano) 2. Sexo: Feminino O (1) Masculino O (2)

3. Qual é a sua profissão: |___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___| NRO (99)
Desempregado O (1) Reformado O (2) Estudante O (3) Inválido O (4)

4. É ex-combatente? Sim, de |___|___|___|___| (Ano) a |___|___|___|___| (Ano) O (1) Não O (0) NRO (99)

5. Sabe ler e escrever? Sim O (1) Não O (0) NRO (99)

6. Frequentou a escola? Não O (0) NRO (99)
Sim, até ao: |___|___|º ano de escolaridade O (1) Sim, |___|___| anos de Ensino Superior O (2)

7. Qual o seu estado civil atual: Solteiro O (1) Viúvo O (2) Divorciado O (3) Casado O (4) NRO (99)

8. E atualmente vive: Sozinho O (1) Maritalmente O (2) Com os pais O (3) NRO (99)

9. Por mês, quanto dinheiro entrou em sua casa - considere todas as pessoas (em Kwanzas): NSNRO (99)
Nenhum O (0) < 15.000 O (1) 15.001 - 30.000 O (2) 30.001 - 45.000 O (3) 45.001 - 60.000 O (4) 60.001 - 75.000 O (5) > 75.000 O (6)

10. Que línguas sabe falar? (Registe os códigos das 3 principais) |___|___| |___|___| |___|___|

11. Qual é a língua em que aprendeu a falar? (Registe o código) |___|___|

12. Qual é a sua religião? Nenhuma O (0) Católica O (1) Protestante O (2) Islamista O (3) Animista O (4) Judaica O (5)
Outra O (6) Especifique: |___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___| NRO (99)

Encaminhar participante para posto #2 (Análise de sangue e urina)

B. Análise de sangue (Posto #2) **ID do aparelho: |___|___|+|___|___|+|___|___|** **ID do Técnico (abreviatura): |___|___|___|**

1. Há quanto tempo fez a sua última refeição? |___|___| horas NR O (99)

2. Glucose |___|___|___| mg/dL O (1) Lo O (2) Hi O (3)

3. Colesterol total |___|___|___| mg/dL O (1) Lo O (2) Hi O (3)

4. Triglicerídeos |___|___|___| mg/dL O (1) Lo O (2) Hi O (3)

C. Urianálise (Posto #2) **ID do Técnico (abreviatura): |___|___|___|**

1. Tem Schistossomíase (também conhecida por Samba, Kussussa, Sangue na Urina)? Sim O (1) Não O (0) NSNR O (99)

		O (1)	O (2)	O (3)	O (4)	O (5)	O (6)	O (7)
2. Albumina	g/L | mg/L	0,01|10	0,03|30	0,08|80	0,15 |150	0,3|300	1|1000	5|5000

		O (1)	O (2)	O (3)	O (4)	O (5)
3. Creatinina	mmol/L | g/L	0,9|0,1	2,2|0,25	8,8|1	17,7|2	>26,5|>3

Encaminhar participante para posto #3 (Dados Antropométricos)

D. Dados antropométricos (Posto #3) **ID da balança: |___|___|** **ID do Técnico (abreviatura): |___|___|___|**

1. Peso |___|___|___|,|___| Kg
2. Altura |___|___|___|,|___| cm
3. Altura sentado |___|___|___|,|___| cm
4. Perímetro de braço |___|___|___|,|___| cm

E. Consumo de tabaco - perguntar depois de recolher dados antropométricos **(Posto #3)**

1. Fuma ou alguma vez fumou tabaco? Sim ○ (1) **Não ○ (0) NSNR ○ (99) → Passa para F**
2. Se sim, começou a fumar aos |___|___| anos de idade NSNR ○ (99)
3. Se sim:
   ○ (1) É ex-fumador → parou há |___|___|___| anos, fumava |___|___| cigarros/dia **→ Passa p/ F**
   ○ (2) Fuma menos de 1 vez/dia
   ○ (3) Fuma pelo menos: |___|___| cigarros/dia |___|___| charutos/cigarrilha/dia Outro: |___|___|___|___|___|___|___|___|___|___|
   ○ (99) NSNR
4. Quanto tempo depois de acordar fuma o primeiro cigarro?
   Após 1 hora ○ (0) Entre ½ hora e 1 hora ○ (1) 6 a 30 minutos ○ (2) até 5 minutos ○ (3) NR ○ (99)
5. Acha difícil não fumar em locais onde é proibido (exemplo: igreja, hospital)? Sim ○ (1) Não ○ (0) NR ○ (99)
6. Qual o cigarro do dia que mais gosta de fumar? O primeiro da manhã ○ (1) Qualquer outro ○ (0) NR ○ (99)
7. Quantos cigarros fuma por dia? < de 10 cigarros ○ (0) entre 11 e 20 ○ (1) entre 21 e 30 ○ (2) mais de 30 cigarros ○ (3) NR ○ (99)
8. Fuma mais frequentemente nas 1as horas após acordar do que no resto do dia? Sim ○ (1) Não ○ (0) NR ○ (99)
9. Fuma mesmo quando está tão doente que tem de ficar na cama a maior parte do dia? Sim ○ (1) Não ○ (0) NR ○ (99)

F. Consumo de álcool **(Posto #3)**

1. Bebe ou alguma vez bebeu bebidas alcoólicas (Vinho, cerveja, maruvo, aguardente)? Sim ○ (1) **Não ○ (0) NR ○ (99) → Passa p/ G**
2. Se sim, começou a beber aos |___|___| anos de idade NSNR ○ (99)
3. Se sim:
   ○ (1) É ex-bebedor → parou há |___|___| anos e bebia habitualmente |___|___| bebidas por dia **→ Passa para G**
   ○ (2) Ainda bebe → avança para próxima questão.
4. No último ano quantas vezes bebeu pelo menos 1 bebida (p.e. lata de cerveja, taça de vinho, copo de whisky)? NR ○ (99)
   Diariamente ○ (1) 5 a 6 vezes/semana ○ (2) 3 a 4 vezes/semana ○ (3)
   1 a 2 vezes/semana ○ (4) 1 a 3 vezes/mês ○ (5) menos de 1 vez/mês ○ (6)
5. No último mês, quantas vezes bebeu 6 bebidas ou mais numa só ocasião? |___|___| dias NR ○ (99)

Encaminhar participante para posto #4 (Electrocardiograma)

G. Electrocardiograma (Posto #4) **ID do aparelho: |___|___|** **ID do Técnico (abreviatura): |___|___|___|**

D5. Perímetro de anca |___|___|___|,|___| cm D6. Perímetro da cintura |___|___|___|,|___| cm

1. Alguma vez realizou um electrocardiograma? Sim ○ (1) Não ○ (0) NSNR ○ (99)
2. Alguma vez realizou um ecocardiograma? Sim ○ (1) Não ○ (0) NSNR ○ (99)

Indicar à supervisora se existe necessidade de encaminhamento → Sim ○ Não ○

Observações: _____

_____

Encaminhar participante para posto #5 (medição de TA)

H. Hábitos alimentares ID do aparelho: |___|___| ID do Técnico (abreviatura): |___|___|___| (Posto #5)

Pressão Arterial Frequência Cardíaca

1ª medição |___|___|___| / |___|___|___| mm Hg |___|___|___| bpm

Numa semana normal, em quantos dias:	Quantas porções come/bebe nesses dias:
1. Come fruta |___| dias	2. fruta |___|___| peça de fruta
3. Come verduras (por exemplo kisaka, couve, erva) |___| dias	4. verduras (por exemplo kisaka, couve, erva) |___|___| porções
5. Bebe café/chá preto |___| dias	6. café/chá preto |___|___| chávena

7. Quantas vezes coloca sal no prato, antes de comer?
Sempre ○ (5) Muitas vezes ○ (4) Algumas vezes ○ (3) Raramente ○ (2) Nunca ○ (1) NR ○ (99)

8. Quantas vezes coloca sal na panela quando prepara a comida em sua casa?
Sempre ○ (5) Muitas vezes ○ (4) Algumas vezes ○ (3) Raramente ○ (2) Nunca ○ (1) NSNR ○ (99)

9. Quantas vezes come comida conservada com sal (carne salgada, peixe seco)?
Sempre ○ (5) Muitas vezes ○ (4) Algumas vezes ○ (3) Raramente ○ (2) Nunca ○ (1) NR ○ (99)

10. Que quantidade de sal é que acha que come?
Exagerado ○ (5) Muito ○ (4) Suficiente ○ (3) Pouco ○ (2) Muito Pouco ○ (1) NR ○ (99)

11. Considera importante reduzir a quantidade de sal na comida?
Muito importante ○ (3) Mais ou menos importante ○ (2) Pouco Importante ○ (1) Não Sabe ○ (0) NR ○ (99)

12. Acha que comer demasiado sal pode ser perigoso para a saúde? Sim ○ (1) Não ○ (0) Não sei ○ (2) NR ○ (99)

13. Que tipo de gordura usa quando prepara comida em sua casa? Outra (7) |___|___|___|___|___|___|___|___|___| NSNR ○ (99)
Óleo de Palma ○ (1) Azeite ○ (2) Óleo comercial (soja, amendoim) ○ (3) Banha ○ (4) Manteiga ○ (5) Margarina vegetal ○ (6)

14. Quantas vezes coloca açúcar na comida/bebida ou come doces e bolos ou bebe gasosas?
Sempre ○ (5) Muitas vezes ○ (4) Algumas vezes ○ (3) Raramente ○ (2) Nunca ○ (1) NR ○ (99)

I. Atividade física (Posto #5)

A sua atividade profissional (mesmo estudante) obriga a: **Não se aplica (Desempregado, reformado, etc) ○ (99) → Passa para 8**

1. Esforços físicos pesados como levantar cargas pesadas, cavar, outros. Sim ○ (1) Não ○ (0) NR ○ (99)
2. Se sim, durante |___|___| dia por semana, por |___|___| horas por dia **ou** menos de 1 hora por dia ○ (1)

3. Esforços físicos moderados como levar cargas leves. Sim ○ (1) Não ○ (0) NR ○ (99)
4. Se sim, durante |___|___| dia por semana, por |___|___| horas por dia **ou** menos de 1 hora por dia ○ (1)

5. Esforços físicos leves como trabalhar à secretária. Sim ○ (1) Não ○ (0) NR ○ (99)
6. Se sim, durante |___|___| dia por semana, por |___|___| horas por dia **ou** menos de 1 hora por dia ○ (1)

7. Como se desloca para o emprego ou escola e quanto tempo demora (ida e volta)?
A pé ou bicicleta |___|___|___|min/dia ○ (1) Carro ou transporte público |___|___|___|min/dia ○ (2) Outro ○ (88) |___|___|___|___|___|

8. Quanto tempo passa por dia sentado(a) a descansar? |___|___| horas por dia **ou** menos de 1 hora por dia ○ (1) NR ○ (99)

9. No último ano praticou desporto ou exercício físico regular?
Sim, durante |___|___| dia/semana, por |___|___| horas por dia **ou** menos de 1 hora por dia ○ (1) Não ○ (0) NSNR ○ (99)

10. A que horas vai dormir numa noite normal de semana de trabalho? |___|___| horas NSNR ○ (99)
11. Se sabe, perguntar a que horas acorda? |___|___| horas
12. Se NSNR, perguntar quantas horas dorme por noite numa semana normal de trabalho? |___|___| horas

13. A que horas vai dormir durante o fim de semana e feriados? |___|___| horas NSNR○ (99)

14. Se sabe, perguntar a que horas acorda? |___|___| horas

15. Se NSNR, perguntar quantas horas dorme durante uma noite de fim de semana ou feriado? |___|___| horas

	Pressão Arterial		Frequência Cardíaca
2ª medição	|___|___|___| /	|___|___|___| mm Hg	|___|___|___| bpm

J. História Obstétrica (só mulheres) (Posto #5)

1. Quando foi a última menstruação? Há |___|___| semanas○ (1) NSNR○ (99)

Não tem menstruação, há |___|___| meses ○ (2) Já não tem menstruação, há |___|___| anos○ (3)

2. Quantos anos tinha quando teve a primeira menstruação? |___|___| anos de idade. NSNR○ (99)

3. Quantas vezes esteve grávida? |___||___| gravidezes Se nenhuma **ou** NSNR○ (99) → passa para 10

4. Quantos bebés nasceram vivos? |___|___| bebés. 5. Quantos abortos teve? |___|___| abortos.

6. Quantos anos tinha quando teve a primeira gravidez? |___|___| anos de idade. NSNR○ (99)

7. Quantos anos tinha quando teve a última gravidez? |___|___| anos de idade. NSNR○ (99)

8. Sabe se alguma vez teve Tensão Alta durante a gravidez? Sim, teve ○ (1) Não teve ○ (0) Não sabe ○ (2) NR○ (99)

9. Se sim, tomou algum medicamento? Sim ○ (1) Não ○ (0) NSNR○ (99)

Usa ou usou alguma medida contraceptiva medicamentosa (medicamento para não engravidar como a "pílula", implante)?

10. ○ (1) Sim, |___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___|___| há |___|___| anos

11. ○ (1) Já usou |___|___|___|___|___|___|___|___|___|___|___|___|___| durante |___|___| anos Nunca usei ○ (2) NSNR○ (99)

12*. Está grávida? Sim ○ (1) Não ○ (0) Não Sabe ○ (2) NR ○ (99)

* Não perguntar se já não tiver menstruação.

K. História clinica pessoal (Posto #5)

1. No último ano quantas vezes foi visto por um profissional de saúde: |___|___| NR ○ (99)

2. Alguma vez, esteve internado? Sim○ (1), porque: |___|___|___|___|___|___|___|___|___|___|___|___|___| Não○ (0) NSNR○ (99)

3. No último mês, esteve internado? Sim○ (1), porque: |___|___|___|___|___|___|___|___|___|___|___|___|___| Não○ (0) NSNR○ (99)

	Tensão Arterial			Diabetes (açúcar no sangue)			Colesterol (gordura no sangue)		
4. Alguma vez um profissional de saúde lhe mediu a/o:	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)
5. Alguma vez um profissional de saúde lhe disse que tinha valores elevados de:	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)
6.* Disseram-lhe isso nos últimos 12 meses:	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)
7.* Nas últimas 2 semanas tomou medicamento prescrito para:	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)
8.* Tomava algum medicamento que já abandonou para a:	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)
9.* Foi a um curandeiro para tratar da:	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)
10.* Está tomar alguma planta, chá ou remédio tradicional para:	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)	Sim ○ (1)	Não ○ (0)	NSNR ○ (99)
11. Se sim à questão 10, indique qual a planta:	|__|__|__|__|__|__|__|__|			|__|__|__|__|__|__|__|__|			|__|__|__|__|__|__|__|__|		

*** Só perguntar se responder sim à situação respetiva na questão 5.**

Alguma vez, algum profissional de saúde lhe recomendou: 12. não fumar:	Sim○(1) Não○(0) NSNR○(99)
13. reduzir o consumo de sal:	Sim○(1) Não○(0) NSNR○(99)
14. comer cinco peças de frutas e/ou porções de vegetais por dia:	Sim○(1) Não○(0) NSNR○(99)
15. reduzir o consumo de gorduras:	Sim○(1) Não○(0) NSNR○(99)
16. fazer exercício físico:	Sim○(1) Não○(0) NSNR○(99)
17. manter um peso saudável ou perder peso:	Sim○(1) Não○(0) NSNR○(99)
18. reduzir a quantidade de bebidas alcoólicas consumidas:	Sim○(1) Não○(0) NSNR○(99)

19. Em geral, diria que a sua saúde é:

Óptima ○(5) Muito boa ○(4) Boa ○(3) Razoável ○(2) Fraca ○(1) NR ○(99)

L. Terapêutica medicamentosa (Posto #5)

1. Esta a tomar medicamentos neste momento (registar apenas os que toma todos os dias): Sim ○(1) Nenhum ○(0) NSNR○(99)

|___|___|___|___|___|___|___|___|___|___|___|___|___| (nome, dosagem), |___|___| por dia, há |___|___| semanas / meses / anos

|___|___|___|___|___|___|___|___|___|___|___|___|___| (nome, dosagem), |___|___| por dia, há |___|___| semanas / meses / anos

|___|___|___|___|___|___|___|___|___|___|___|___|___| (nome, dosagem), |___|___| por dia, há |___|___| semanas / meses / anos

|___|___|___|___|___|___|___|___|___|___|___|___|___| (nome, dosagem), |___|___| por dia, há |___|___| semanas / meses / anos

|___|___|___|___|___|___|___|___|___|___|___|___|___| (nome, dosagem), |___|___| por dia, há |___|___| semanas / meses / anos

	Pressão Arterial		Frequência Cardíaca
3ª medição	|___|___|___| /	|___|___|___| mm Hg	|___|___|___| bpm

Referenciação para consulta no HGB / consulta pré-natal — Confirmar pelo Supervisor

Indivíduo com (Preencher pelos postos, confirmado pelo Supervisor):

- ☐ pressão arterial sistólica (PAS) ≥ 140 mmHg e/ou pressão arterial diastólica (PAD) ≥ 90 mmHg
- ☐ PAS ≥ 140 mmHg e/ou PAD ≥ 90 mmHg com uso de terapia medicamentosa anti-hipertensiva
- ☐ valor de glicemia ≥ 126 mg/dL em jejum ou ≥ 180 mg/dL se não estiver em jejum
- ☐ valor de colesterol total ≥ 200 mg/dL ou triglicerídeos ≥ 150 mg/dL
- ☐ alterações no seu ECG (anexar relatório técnico)
- ☐ outro: _____

Encaminhamento para consulta (Preencher pelo Supervisor):

- ☐ Sim. Data da Consulta: ____ / ____ / _____ *(certificar que cartão preenchido entregue ao indivíduo → ○)*
- ☐ Não. Porque? _____
- ☐ Indicação para inscrever-se nas consultas pré-natais.

Hora de fim: |___|___| h |___|___| m

Observações:

- ☐ ECG encaminhado para análise por cardiologista, sem marcação de consulta.
- ☐ Outra: _____

_____

Annexe II

Study Flyer

Estudo dos fatores de risco cardiovasculares numa população adulta do Bengo

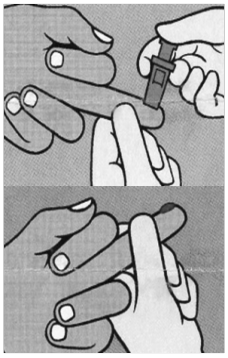
Informações para as pessoas que vão entrar no estudo

Visita às casas escolhidas do bairro e conversa com as pessoas escolhidas à sorte

1 a 2 dias depois, visita de toda a equipa – deve apresentar-se em jejum e trazer consigo as caixas dos medicamentos que toma

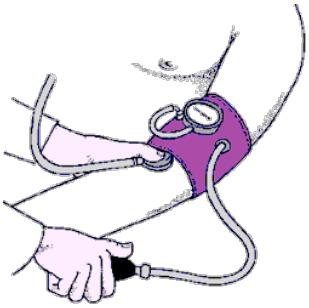
Inscrição das pessoas escolhidas, Entrega de frascos de urina

Medição da Altura e Peso

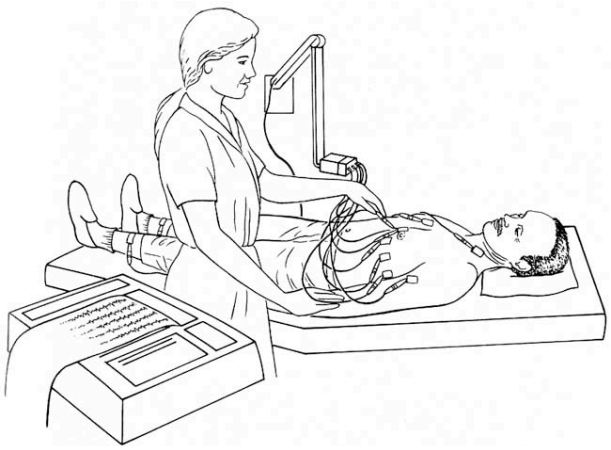


Picada no dedo para tirar sangue (4 a 5 gotas) e teste à urina

Realização de Questionário



Medição da Tensão Arterial



Realização de Electrocardiograma

Inconvenientes Possíveis/ Contra-indicações

- **Dor ou desconforto com a recolha de sangue (pequena picada).**
- **Incómodo pela situação de estar em jejum – será dada refeição ligeira no fim.**
- **Se estiver grávida ou souber que tem alguma doença do coração, deve avisar a equipa.**

CISA CENTRO DE INVESTIGAÇÃO EM SAÚDE DE ANGOLA

ISPUP INSTITUTO DE SAÚDE PÚBLICA DA UNIVERSIDADE DO PORTO

Estudo dos fatores de risco cardiovasculares numa população adulta do Bengo

Informações para as pessoas que vão entrar no estudo

Somos uma equipa do Projecto CISA (Centro de Investigação em Saúde em Angola) e gostaríamos de alguns minutos da sua atenção – gostaríamos de falar com o Sr(a) _____.

Estamos a fazer um estudo sobre algumas doenças na comunidade (doenças do coração e dos vasos sanguíneos). Este trabalho vai permitir conhecer a dimensão destes problemas e os resultados serão partilhados com o Ministério da Saúde de Angola, e com a Direção Provincial de Saúde que autorizou este estudo.

O Sr(a) foi escolhido(a) pelo que precisamos que apareça às _____ horas na _____ª feira, dia _____de _____, no local combinado (ver abaixo) para participar.

Precisamos que venha em jejum e traga consigo as caixas vazias dos medicamentos que costuma tomar.

Pedimos a sua colaboração para o seguinte:

- Doação de amostra de urina e sangue. Com estas amostras serão feitos testes no dia da visita, e outros no laboratório do CISA, e se tiver algum problema será posteriormente seguido no Hospital Provincial do Bengo. A urina serve para saber se o seu rim funciona bem; e o sangue para saber se tem gordura ou açúcar.
- Medir a sua tensão arterial e fazer um electrocardiograma.
- Queremos ainda conversar consigo e fazer algumas perguntas relacionadas com estes problemas de saúde.

A sua colaboração é voluntária pelo que tem o direito de recusar, contudo se aceitar estará a ajudar a saúde da comunidade. Toda a informação que nos der nunca será usada associada ao seu nome.

Hora e data da visita ao bairro para os exames: _____

Local da visita: _____

Nota: Por favor, traga consigo o seu bilhete de identidade, cartão de saúde.

CISA CENTRO DE INVESTIGAÇÃO EM SAÚDE DE ANGOLA

ISPUP INSTITUTO DE SAÚDE PÚBLICA DA UNIVERSIDADE DO PORTO

Annexe III

Informed consent

Consentimento Informado

Estudo dos fatores de risco cardiovasculares numa população adulta da Província do Bengo

Eu, _____, aceito participar de forma voluntária, no "**Estudo dos fatores de risco cardiovasculares numa população adulta da Província do Bengo".** Foi-me explicado que este trabalho pretende conhecer o número de pessoas que possam ter doenças cardiovasculares (doenças do coração e dos vasos sanguíneos) na área de estudo do CISA, quais os meus hábitos alimentares e de consumo de álcool e tabaco, atividade física, o meu conhecimento sobre estas doenças e quais os tratamentos e diagnósticos que já fiz.

Depois de explicados os objectivos deste estudo (conforme panfleto que fica em minha posse) fui informado/a que a minha participação, após um jejum de 8h, consiste na:

- medição da pressão arterial, frequência cardíaca, peso, altura, perímetro abdominal, e da anca e do braço;
- realização de electrocardiograma;
- recolha de uma amostra de sengue para medição de colesterol, triglicerídeos (gordura), glucose (açúcar) e análises genéticas posteriores no laboratório CISA.
- recolha de uma amostra de urina para medição de creatinina/albumina;
- resposta a um questionário.

Fui ainda informado/a que:

- só terão acesso aos dados os trabalhadores do CISA envolvidos neste estudo;
- a publicação dos resultados deste estudo nunca permitirá a minha identificação;
- Se houver necessidade de tratamento serei encaminhado para a unidade sanitária mais próxima de casa.

_____ Se menor de 18 anos: Concordo com a participação do meu encarregando de educação

(Assinatura ou impressão digital do participante)

_____

(Assinatura ou impressão digital do encarregado de educação)

_____ _____

(Assinatura do profissional do CISA) (Data)

Consentimento Informado

Estudo dos fatores de risco cardiovasculares numa população adulta da Província do Bengo

Eu, _____, aceito participar de forma voluntária, no "**Estudo dos fatores de risco cardiovasculares numa população adulta da Província do Bengo".** Foi-me explicado que este trabalho pretende conhecer o número de pessoas que possam ter doenças cardiovasculares (doenças do coração e dos vasos sanguíneos) na área de estudo do CISA, quais os meus hábitos alimentares e de consumo de álcool e tabaco, atividade física, o meu conhecimento sobre estas doenças e quais os tratamentos e diagnósticos que já fiz.

Depois de explicados os objectivos deste estudo (conforme panfleto que fica em minha posse) fui informado/a que a minha participação, após um jejum de 8h, consiste na:

- medição da pressão arterial, frequência cardíaca, peso, altura, perímetro abdominal, e da anca e do braço;
- realização de electrocardiograma;
- recolha de uma amostra de sengue para medição de colesterol, triglicerídeos (gordura), glucose (açúcar) e análises genéticas posteriores no laboratório CISA.
- recolha de uma amostra de urina para medição de creatinina/albumina;
- resposta a um questionário.

Fui ainda informado/a que:

- só terão acesso aos dados os trabalhadores do CISA envolvidos neste estudo;
- a publicação dos resultados deste estudo nunca permitirá a minha identificação;
- Se houver necessidade de tratamento serei encaminhado para a unidade sanitária mais próxima de casa.

_____ Se menor de 18 anos: Concordo com a participação do meu encarregando de educação

(Assinatura ou impressão digital do participante)

_____

(Assinatura ou impressão digital do encarregado de educação)

_____ _____

(Assinatura do profissional do CISA) (Data)

Annexe IV

Information card

Nome: _____

Data Nascimento: |___||___| - |___||___| - |___||___||___||___|

Glicemia	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Colesterol Total	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Triglicéridos	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Tensão Arterial	/	/	/	mmHg
Data:	/ /	/ /	/ /	

Nome: _____

Data Nascimento: |___||___| - |___||___| - |___||___||___||___|

Glicemia	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Colesterol Total	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Triglicéridos	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Tensão Arterial	/	/	/	mmHg
Data:	/ /	/ /	/ /	

Nome: _____

Data Nascimento: |___||___| - |___||___| - |___||___||___||___|

Glicemia	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Colesterol Total	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Triglicéridos	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Tensão Arterial	/	/	/	mmHg
Data:	/ /	/ /	/ /	

Nome: _____

Data Nascimento: |___||___| - |___||___| - |___||___||___||___|

Glicemia	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Colesterol Total	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Triglicéridos	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Tensão Arterial	/	/	/	mmHg
Data:	/ /	/ /	/ /	

Nome: _____

Data Nascimento: |___||___| - |___||___| - |___||___||___||___|

Glicemia	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Colesterol Total	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Triglicéridos	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Tensão Arterial	/	/	/	mmHg
Data:	/ /	/ /	/ /	

Nome: _____

Data Nascimento: |___||___| - |___||___| - |___||___||___||___|

Glicemia	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Colesterol Total	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Triglicéridos	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Tensão Arterial	/	/	/	mmHg
Data:	/ /	/ /	/ /	

Nome: _____

Data Nascimento: |___||___| - |___||___| - |___||___||___||___|

Glicemia	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Colesterol Total	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Triglicéridos	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Tensão Arterial	/	/	/	mmHg
Data:	/ /	/ /	/ /	

Nome: _____

Data Nascimento: |___||___| - |___||___| - |___||___||___||___|

Glicemia	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Colesterol Total	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Triglicéridos	|__|__|__|	|__|__|__|	|__|__|__|	mg/dL
Tensão Arterial	/	/	/	mmHg
Data:	/ /	/ /	/ /	

Cartão de monitorização de valores clínicos

CISA
CENTRO DE INVESTIGAÇÃO EM SAÚDE EM ANGOLA

Caxito, Bengo

Cartão de monitorização de valores clínicos

CISA
CENTRO DE INVESTIGAÇÃO EM SAÚDE EM ANGOLA

Caxito, Bengo

Cartão de monitorização de valores clínicos

CISA
CENTRO DE INVESTIGAÇÃO EM SAÚDE EM ANGOLA

Caxito, Bengo

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CISA
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CENTRO DE INVESTIGAÇÃO EM SAÚDE EM ANGOLA

Caxito, Bengo

Annexe V

Reference for medical follow-up

Folha de encaminhamento para seguimento clínico

Estudo dos fatores de risco cardiovasculares numa população adulta da Província do Bengo

_____, com _____ anos de idade, participou no "**Estudo dos fatores de risco cardiovasculares numa população adulta da Província do Bengo".** Neste sentido, realizou um conjunto de exames de diagnóstico no dia ____/____ , apresentando os seguintes resultados:

Pressão Arterial de: |___|___|___| / |___|___|___| mm Hg Frequência Cardíaca de |___|___|___| bpm

Glucose de |___|___|___|mg/dL em _____ Colesterol total|___|___|___|mg/dL Triglicerídeos|___|___|___|mg/dL

Peso: |___|___|___|,|___| Kg; Altura: |___|___|___|,|___| cm; Anca: |___|___|___|,|___| cm; Cintura: |___|___|___|,|___| cm

Consideramos que necessita de avaliação médica para eventual tratamento adequado, uma vez que:

- ☐ pressão arterial sistólica (PAS) ≥ 140 mmHg e/ou pressão arterial diastólica (PAD) ≥ 90 mmHg
- ☐ PAS ≥ 140 mmHg e/ou PAD ≥ 90 mmHg com uso de terapia medicamentosa anti-hipertensiva
- ☐ valor de glicemia ≥ 126 mg/dL em jejum ou ≥ 180 mg/dL se não estiver em jejum
- ☐ valor de colesterol total ≥ 200 mg/dL ou triglicerídeos ≥ 150 mg/dL
- ☐ alterações no seu ECG (relatório técnico em anexo)
- ☐ Outra: _____

Observações: _____

_____

_____

Data:_____ Assinatura do profissional de saúde:_____

Contacto para mais informações: 945731743 (Enf.ª Ana Maria Oliveira)

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Folha de encaminhamento para seguimento clínico

Estudo dos fatores de risco cardiovasculares numa população adulta da Província do Bengo

_____, com _____ anos de idade, participou no "**Estudo dos fatores de risco cardiovasculares numa população adulta da Província do Bengo".** Neste sentido, realizou um conjunto de exames de diagnóstico no dia ____/____ , apresentando os seguintes resultados:

Pressão Arterial de: |___|___|___| / |___|___|___| mm Hg Frequência Cardíaca de |___|___|___| bpm

Glucose de |___|___|___|mg/dL em _____ Colesterol total|___|___|___|mg/dL Triglicerídeos|___|___|___|mg/dL

Peso: |___|___|___|,|___| Kg; Altura: |___|___|___|,|___| cm; Anca: |___|___|___|,|___| cm; Cintura: |___|___|___|,|___| cm

Consideramos que necessita de avaliação médica para eventual tratamento adequado, uma vez que:

- ☐ pressão arterial sistólica (PAS) ≥ 140 mmHg e/ou pressão arterial diastólica (PAD) ≥ 90 mmHg
- ☐ PAS ≥ 140 mmHg e/ou PAD ≥ 90 mmHg com uso de terapia medicamentosa anti-hipertensiva
- ☐ valor de glicemia ≥ 126 mg/dL em jejum ou ≥ 180 mg/dL se não estiver em jejum
- ☐ valor de colesterol total ≥ 200 mg/dL ou triglicerídeos ≥ 150 mg/dL
- ☐ alterações no seu ECG (relatório técnico em anexo)
- ☐ Outra: _____

Observações: _____

_____

_____

Data:_____ Assinatura do profissional de saúde:_____

Contacto para mais informações: 945731743 (Enf.ª Ana Maria Oliveira)